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CAUSAL AND TEMPORAL BASES OF ORGANIZATION
OF MEANINGFUL VERBAL INFORMATION

by



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A THESIS

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "Causal and Temporal Bases of Organization of Meaningful Verbal Information", submitted by Ralph Y. Sasson in partial fulfillment of the requirements for the degree of Master of Science.

ABSTRACT

It was thought that meaningful relationships between parts of meaningful verbal material or information play a major role in the organization of such information. This study attempted to determine the prepotencies and the effect on (serial anticipation) learning of organizations based on different meaningful inter-part relationships. It was hypothesized that (1) arrangement or organization of information or verbal material in both a cause-effect and temporal sequence would facilitate learning of that material to a greater extent than arrangement in any of the other sequences employed in the study; and (2) that the causal type of organization would have greater facilitative effect on learning than the temporal type of organization.

In Experiment I three groups of Ss were played twice on a tape-recorder a list of sentences. The sentences were identical in all cases except for the fact that their organization or ordering upon presentation differed. One list had a causal organization, with a temporal organization within it, another had a causal but no temporal organization, and the third had an organization based on the subject or individual connected to a particular event. Following the second sentence presentation, Ss in each group underwent five trials of serial anticipation learning on the list they heard (i.e., they had, by this method, to learn the sentences in the order they were

presented). Results showed that learning was greatest when the sentences were organized both causally and temporally. However, there was no significant difference in mean learning performance (averaged across Ss and trials) between the other two groups. Interpretations of these results were given.

Experiment II was an attempt to determine whether the causal organization is "superior" to (in the sense of greater facilitative effect on learning) the temporal one. The first group of Ss was played twice on a tape-recorder a list of sentences organized causally (but not temporally). Following the second presentation, they underwent four trials of serial anticipation learning. They were then presented with two recordings of the identical sentences, this time organized temporally and again underwent four trials of serial anticipation learning for this list. The second group had exactly the same tasks to perform, except in a reverse order : the temporal learning first and the causal learning second. In addition, two control groups were used. Each of these control groups had first to learn by serial anticipation (and for four trials) a list of irrelevant sentences (after these were played twice on a tape-recorder). Following this task, they were played twice either the temporal or causal list and underwent four serial anticipation trials for one of these lists.

In both experiments the sentences were divided into phrases and recall on any given trial was computed in terms of the ratio of

the number of phrases correctly recalled to the total number of phrases in the list.

Results revealed that learning performance (averaged over Ss and trials) was significantly greater on causally organized sentences than on temporally organized sentences. Furthermore, more transfer on, or greater facilitation of subsequent learning was obtained from previous causal learning than from previous temporal learning. Other findings were that prior irrelevant learning has no significant effect on subsequent learning, and that prior relevant learning, organization aside, has a facilitative effect on subsequent learning. Reasons that might account for the finding that the causal organization is superior or prepotent to the temporal organization were given.

It was concluded that meaningful inter-part relationships definitely play a role in the organization and learning of meaningful information and that, while both a causal and temporal form of organization is the most effective in learning, the causal organization is superior to the temporal one. It was noted, however, that other types of organization or inter-part relationships, may be effective in learning, particularly those that are derived from the combinations of the causal, temporal, and sub-based organizations.

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Ralph Y. Sasson

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CHAPTER I

INTRODUCTION

Beginning a few years ago, serious attention to organizational variables in retention and learning, has been continuously increasing. This increasing attention should be welcomed for the reason that organizational factors are very important, if not central, to learning activities and cognitive processes, in general. An individual, for example, who is confronted with the task of learning a large body of unfamiliar verbal material (e.g. the psychology of learning) will not proceed automatically and with unthinking ease, but will try to interrelate the component parts of this material so as to develop a logical, coherent sequence and will try to perceive this sequence.

Organization occurs in other situations as well - e.g., giving a lecture, writing an essay or a book. The lecturer does not present items of information in the order in which he happens to recall them at the moment. Rather, his presentation is governed by inter-relationships between the items. He will group items which are similar, and relate them in ordered sequence. Similarly, a writer will not mention his ideas in any random order. He will mention related ideas in the same part of the book, and unrelated ideas in different parts of the book. He will let different topics be different chapters of the book and relate similar sub-topics under one topic.

Organization, then, being an important and recurring factor in mental functioning, its laws have to be considered if an eventual comprehensive theoretical understanding of human intellectual behaviour is to be expected. Yet, research directed at precisely that goal - of unmasking organizational variables - has typically concerned itself with the incidental characteristics of inter-item relationships and item features, and with the role played by the use of artificial mnemonic relations in organizational processes. It has not in most cases concerned itself with the clearly more effective meaningful ways of relating material.

It will be the goal of this study to show what possible types of meaningful inter-part relationships can provide a basis for the organization of meaningful verbal material. More precisely, it will attempt (1) to determine the prepotencies or order of predominance, if any, of organizations based on different semantic inter-part relationships, and (2) to determine the effects of these different kinds of organizations (of meaningful verbal information) on (serial anticipation) learning.

Before proceeding to a presentation of this investigation, let us review the preceding work in research on organizational factors.

Category Clustering

Clustering refers to the sequential organization during free

recall of items that are related to one another in some way, even though these items were randomly presented during study trials.

In Bousfield's (1953) words a cluster is "a sequence of associates having an essential relationship between its members."

Cofer (1964) has termed category clustering that type of clustering which occurs when the items recalled in adjacent positions or in a group are representative of distinguishable taxonomic categories.

One of the earliest experiments¹ to note this phenomenon was that of Bousfield (1953). In this study, subjects (Ss) were given ten minutes to list all of the words they could recall from a list of 60 items. The items were presented randomly and were made up of four 15-item categories : animals, names, professions and vegetables. The experimenter found that Ss showed a greater than chance tendency to place items in clusters which contained members of the same category. However, Bousfield did not include a control condition in which Ss had to recall a list of taxonomically unrelated words and thus prevented the possibility of a comparison between total recall scores for clustered and unclustered lists. Cofer (1959) in a study employing the same general procedure also obtained evidence for the clustering phenomenon. He made use of two lists of words, one composed of groups of synonyms and the other composed of unrelated words. Results showed no difference in number of words recalled between the lists, but showed the existence of clustering in the list containing the synonyms.

A number of variables have been related to the degree of clustering. Bousfield and Cohen (1953) found that clustering increases with the number of list presentations (or reinforcements). Clustering was found to be greater for high frequency (Thorndike-Lorge counts) than for low frequency words (Bousfield and Cohen, 1955) and also for high frequency taxonomic responses² than for low (Bousfield, Cohen and Whitmarsh, 1958).

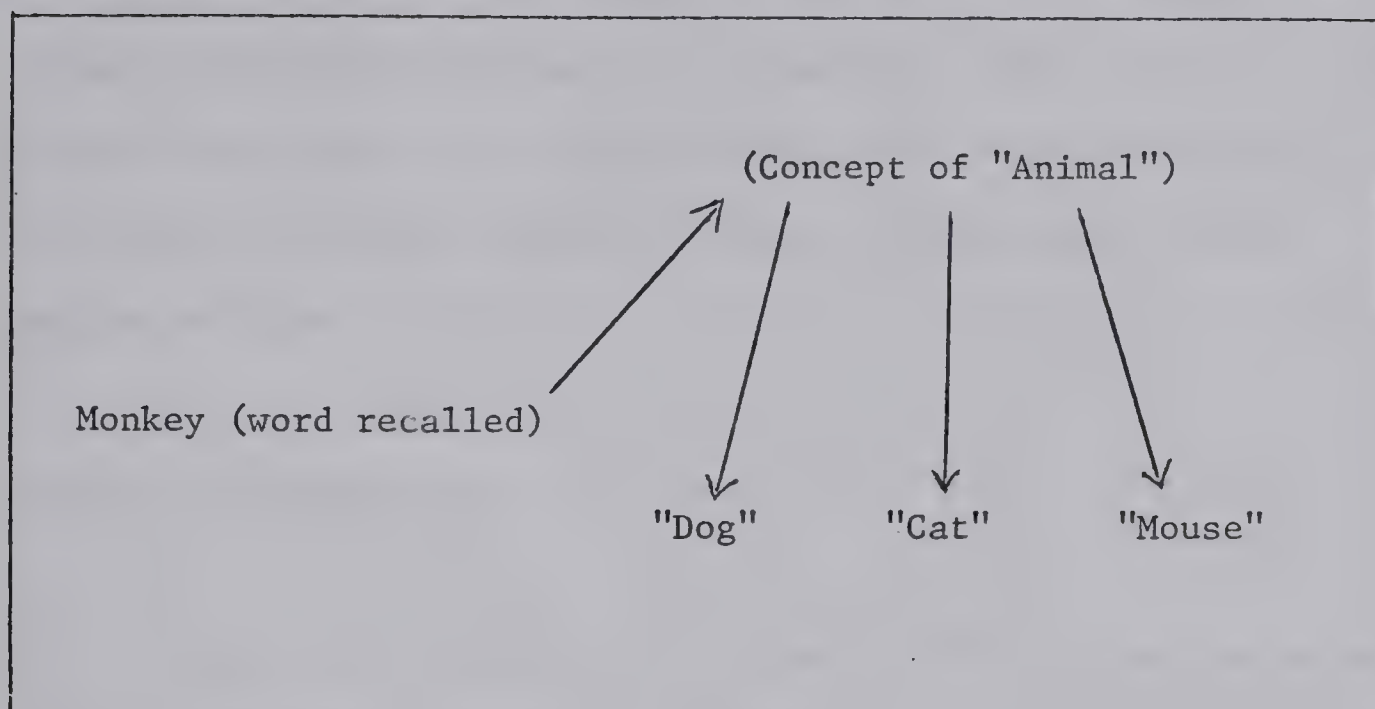
Another question which has been investigated is recall as a function of the number of categories in the list. In an experiment by Mandler (1966) Ss had to sort sets of words into a number of categories of their own choice, and had to continue in this activity until they arrived at a consistent set of categories indicated by the production of two identical sorts in succession. Once this was reached Ss were asked to recall as many words as they could remember. It was found that recall increases linearly with number of categories and that it is independent of the number of trials required to reach the sorting criterion. Mathews (1954) also obtained results of this nature. He divided 24 items (individuals' names) into either two, three, or six occupational categories, i.e. artist, scientist, etc. The names in each category were equated on the basis of controlled-association data. Ss had to first identify each name as belonging to one of either two, three or six categories and had then to recall these names. Mathews found that recall significantly increased the greater the number of categories used in classifying the items. These findings have been confirmed by Bousfield and Cohen (1956).

An extensive investigation by Dallett (1964), however, has indicated that the area is more complex than it appears to be and that the length of the list is an influential variable in the results that are obtained. Dallett found that with a list of 12 words, recall was a curvilinear function of the number of categories, and that with a list of 24 words recall was an inverse function of the number of categories. As Kausler (1966) has pointed out, though, "There is a strong possibility that the effect of number of categories may be confounded by the extent of intra-cluster word associations in a given list (i.e., the tendency of the words to be associates of one another). Since the extent of such associations is uncontrolled in these studies, differential amounts of associations in the lists employed may account for the disparity in findings."

To explain the category clustering phenomenon Bousfield argues that when a S recalls a particular word, that word activates a general superordinate concept (the name of a class, for instance), and that concept in turn arouses other words which are instances of the same concept. The concept need not be a particular word or class name. Importantly, then, clustering can be mediated and it doesn't have to be direct. Bousfield's account of clustering is illustrated in Fig. 1.

FIGURE I

BOUSFIELD'S (1953) ACCOUNT OF THE PROCESS
OF CATEGORY CLUSTERING IN RECALL



Of three studies (Bousfield, Steward and Cowan, 1964; Bousfield and Puff, 1964; Cohen, 1963) that experimentally tested the principle of superordination, only the first two found support for it. Cohen (1963) performed an experiment with two types of categories, exhaustive and non-exhaustive. The former categories consisted of sets like NORTH-EAST-SOUTH-WEST, or FRESHMAN-SOPHOMORE-JUNIOR-SENIOR; the latter categories were made up of four words drawn from much larger categories such as BEAR-HORSE-DOG-LION. The words from different categories were randomly presented in a list that had to be recalled. The results of the experiment showed that words from exhaustive categories were not only more likely to be recalled but also better clustered than the words from non-exhaustive categories. The major point of the experiment,

however, was that these differences were parallel to differences in free associations. These results thus seem to support a free association interpretation of category clustering. It should be observed, though, that in spite of the fact that words from exhaustive categories were equally likely to evoke a category name as were words from non-exhaustive categories, there was no control, in this study either, for intra-cluster word associations, and that this fact might have been a factor in the nature of the results obtained.

Associative Clustering

In a study by Jenkins and Russell (1952), Ss had to recall a list of 48 words composed of stimulus and response pairs obtained from the Kent-Rosanoff association test. Although the words were presented randomly, Ss showed a significant tendency to recall words in their stimulus-response sequence (e.g., "table" and "chair"). Reversed associations, "chair - table", had a significantly higher than chance frequency of occurrence but a significantly lower one than forward associations.

Clustering of this type, based on free association, has been termed associative clustering and hence refers to the chained elicitation of associates during free recall.

A number of studies have been carried out on associative

clustering and some interesting findings have been obtained. Jenkins, Miuk and Russell (1958), and Matthews, Marcer and Morgan (1964) found that the extent of associative clustering increases monotonically as a function of increasing associative strength between the word pairs. Another investigation (Underwood, Runquist and Schulz, 1959), suggested the possibility of clustering by response synonymity in paired associates acquisition. In a later study, Cofer and Bruce (1965) examined the question of the occurrence of clustering when the superordinate categories activated by a naming response contained items which were not associated. The results of their experiment revealed no evidence for clustering on the basis of form class categories (nouns, adjectives and verbs) when the items within a form class were not related associatively. It should be kept in mind, however, that this does not mean that recall is unorganized, but just that form class categories are inadequate as a basis of organization.

Deese (1959, 1961, 1962) obtained a measure or an index of interitem associative strength. The index measures the average relative frequency of the tendency for all the words in a list to elicit each other by free association. In the 1959 study, Deese constructed 15-item lists of variable degrees of associative organization by selecting 15 high-frequency associates to previously chosen stimulus words (from the Minnesota words norms). For each S, Deese determined the relative frequency of associates to a stimulus word to elicit each other and used the average of these frequencies as the list's interitem associative strength. He found a positive relationship between

degree of interitem associative strength existent in the lists and amount of free recall.

Other research efforts in this area have been made by Cofer (1965) who has attempted to contrast associative and categorical clustering. His general procedure has been to compare sequential recall for pairs of words which belong to the same category (e.g., BED-CHAIR, as items of furniture) with sequential recall for pairs of words which do not (e.g., BED-SLEEP) when both kinds of pairs have been equated for the amount of overlapping associations. The findings of this research suggest that opportunity for categorization enhances the amount of clustering to a greater extent than is common if free association were alone operating.

Another individual who has been concerned with the relationship between associational and categorical clustering is Postman (1964). Postman pointed out :

The relationship between the two types of clustering remains uncertain. Associative clustering appears to reflect directly the associative structure of the words in the list, and no recourse to a mediational process is compelled by the data. (However) . . . some forms of category clustering strongly suggest mediation by cue-producing responses. The question now is whether it is necessary to assume two distinct types of clustering, and if it is, what their relative priorities are in determining sequential order in recall.

One of the difficulties lies in the concept of association itself. It can, of course, be said that a word is strongly associated

with another word (that is, it has a strong likelihood of evoking that other word) because the two words have occurred contiguously in the past. However, if we ask why the words have occurred contiguously in the past we are forced to conclude that it is because the words must have had originally (and still have) some kind of relationship to each other, be it belongingness to the same category, or involvement of common actions critical to their definition (e.g., Chair-Sit), or some other kind of relationship. Nobody can say for sure that the S does not see these kinds of relationships between words and that these relationships do not play their part when recall of words that are strong free-associates of one another is involved. That is, no one can say whether it is merely past contiguous occurrences or some other relationship that is responsible for the evocation of a strong free-associate.

Another problem lies in the behaviour of the subject himself. Assuming that in any given recall task, the S will attempt to recall as much of the verbal stimuli as possible, it follows that he will employ the most efficient means to accomplish his recall. This means that in a recall task he might be using both types of organization, (associative and categorical) since their simultaneous use might, depending on the situation, be more efficient than the use of either one alone. The question thus becomes in what situations will the S be using an associative kind of organization, in what situations will he be using a categorical one, and in what situations will he be using both. This question points out the necessity of having a clear

conceptualization of what the task necessitates or demands of the S. For if that is known and if it is assumed that the S will employ the most efficient and the most economical way to accomplish his recall (in the Brunerian sense of less mental strain) then we can predict with a certain degree of probability what kind of organizational processes occurred during the task. Experimentally, this means that tasks necessitating different requirements on the part of the Ss should be given and the organizational behaviour of the Ss on these different tasks should be determined. This would enable us to know what Ss do on tasks which necessitate certain types of behaviour but not others.

Sequential Dependencies

Another factor which has been considered as providing a possible source of organization in acquisition has been that of sequential structure. In the English language (and in others as well) the probability of appearance of a word in a given sequence depends on the other words that are present. Words can thus be arranged in predictable sequences and it is possible to vary the degree of sequential structure or sequential constraint (i.e., the statistical likelihood of occurrence) of words in a particular sequence. These sequences in which the degree of sequential structure or dependencies is varied have been called approximations to English. It should be noted that this order of approximation concept is based on an assumed Markov generator. Since with higher and higher orders of approximation to

English more of our everyday language habits can be used in recall, the problem in this area is thus to determine the effects of language habits on learning or whether language habits are used as an organizational factor in learning.³

One of the first studies to try and come to grips with this problem was that of Miller and Selfridge (1950). The latter played on a tape-recorder sequences of 10, 20, 30 and 50 words which varied in approximation to English from zero-order (i.e., words chosen at random) to seventh-order, plus some text passages. After each sequence was played Ss had to recall as many words as they could and were scored for the total number of correct words without regard to their order of recall. Results revealed a positive, negatively accelerated, function between approximation to English and number of words recalled. Furthermore, the facilitation from increasing approximation to English seemed to increase as the length of the sequence increased; and finally little change occurred from the fifth-order approximation to text. Sharp (1958) and Richardson and Voss (1960) replicated these results.

Miller and Selfridge (1950), in interpreting their findings, suggested that the increasing meaningfulness of the sequences as they increased in their degree of approximation to English might be one of the factors causing superior recall at higher-order approximations. As Johnson (1968) has pointed out, however, there may be other variables operating as well. First, as approximation to English increases

there is also an increase in the degree to which the sequences resemble the grammar of the language. The contribution to learning of the latter variable may be different from that of increasing meaningfulness. Secondly, there might exist in the sequences interitem associations whose strength increases as the degree of approximation increases and this may be a variable that operates independently of the above-mentioned two.

A number of investigators have been concerned with the influence on learning of increasing determination of word order that is provided by the increasing approximation to the grammar of the language (as order of approximation to English increases). Marks and Jack (1952) found that recall scores of words in the correct order were superior for text material than for higher-order approximations. Colman (1963) obtained similar results using a free recall procedure, and controlled, in addition, for differences in the difficulty of items in the various approximations to English - differences which might have been present in the other studies. Colman not only scored for the correct recall of single words, but also for the number of two-word sequences recalled; three-word sequences; etc., up to the number of seventeen-word sequences recalled. For scores based on recall of single words, the function relating free recall and degree of approximation was negatively accelerated, like that of Miller and Selfridge (1950); but unlike the latter, however, Colman found significant differences in recall between fifth-order approximations and text material. Furthermore,

as the size of the scored sequence increased, the shape of the function between sequence size and order of approximation shifted gradually from negative to positive acceleration. Johnson (1968) points out that these findings suggest that "the failure of Miller and Selfridge to obtain a difference between text and fifth-order approximations may have been a function of both the nature of the materials they used and the fact that their scoring method did not take sequential constraints into consideration."

Since in the Colman study, it was also found that the scores of longer word-sequences reflected to a greater degree the use of sequential dependencies, and since sequence size was found to be positively related to order of approximation, the results also show that degree of sequential constraint is positively correlated with order of approximation to English. This finding was also obtained by Postman and Adams (1960) and Tulving and Patkau (1962). (Another interesting finding obtained by Tulving and Patkau was that for approximation to English sequences made up of low frequency words (Thorndike-Lorge counts), the rate of increase in recall across approximations was significantly less than for sequences consisting of high frequency words. This, of course, would argue for the fact that word frequency is a variable present in the function relating sequential dependencies and recall). One other variable was also discussed as a possible one present in the sequential constraint and recall relationship : that of item-to-item associations. The evidence so far, however, (Johnson, 1966; Johnson, 1965; Frankart, 1964) does not

support the notion that increasing sequential constraints reflect increasing word-to-word associations.

Grammaticality, Meaningfulness and Learning

In the preceding section, four variables were mentioned as being possibly operative in the approximation to English and recall function : sequential constraint; interitem associations; grammaticality of word sequences; and meaningfulness of these sequences. The first two of these factors have been discussed, and presently the last two shall be taken up.

One of the first studies to attempt to assess the effect of grammaticality on learning was that of Swanson (reported in Osgood, 1957). To reduce the influence of meaning and prior associations, Swanson used sequences in which the grammaticality of English was retained but in which nonsense words were substituted for nouns, verbs, etc. A syntactic sequence, for instance, was "The maff velms oothly um the glox nerfs", and an unsyntactic one was "Maff velm ooth um glox nerf". Thus some Ss learned the first type of sequence and others learned the second type of sequence. The results showed that even though they were longer, learning of the syntactic sequences was more rapid. Other experimenters (Marks and Miller, 1964; Colman, 1965; Johnson, 1965; Epstein, 1961, 1962, 1963;) have reported similar results. It should be noted, however, that the point was made (Johnson, 1968) that " . . . while reliable differences are

consistently obtained between grammatical and ungrammatical material, the absolute differences are relatively small when compared to the differences between anomalous and meaningful sequences when both are grammatically correct." In addition, some experimenters have reported that they have failed to obtain an effect on learning from grammaticality (Rosenberg, 1964; Moran, 1965). It may be that the facilitation provided by grammar, while present, is small.

In a more detailed study by Johnson (1965), this hypothesis seems to be borne out. Johnson was concerned with the extent to which grammar provides Ss with a "ready-made and reliable recording scheme". He assumed that the Ss would learn the sentences he gave them in terms of "phrase-size chunks or recall units" and that the words within each such unit would be more dependent upon one another as recall events than would words in different units. Thus if one scores the Ss's responses for the probability that each word in a sentence would be wrong given that the preceding word would be right, one can discover the boundaries between the assumed recall chunks in that a high probability of transitional error (TEP) should occur at the point separating any two recall chunks. The nature of these recall chunks should also be revealed from the pattern of TEPs for a given sentence. Johnson had Ss in the first group learn eight sentences whose grammatical structure is shown by "The tall boy saved the dying woman", and Ss in the second group learn sentences like "The house across the street burned down". It was found that TEPs for between-chunk or between-phrase transitions (e.g. boy-saved,

"The tall boy" being the first phrase), for both types of sentences were higher than TEPs for within-phrase transitions (e.g. the-tall). Also found was the inequality of within-phrase transitions. Johnson reports that the pattern of within-phrase TEPs was correlated with the structure of the phrase itself and thus this shows that the unit structure of a sequence can have an effect on learning. Other investigators (Suci, 1964; Odom, reported in Johnson, 1968) obtained similar results.

The role that meaningfulness of verbal items plays in learning and retention has been considerably investigated and a number of points of views regarding the concept of meaning as well as its function in acquisition have been put forth (e.g. Underwood, 1959, 1960; Noble, 1953; Osgood, 1957). Albeit interesting a synopsis of theories regarding the concept of meaning shall not be presented, however, since this would take us far afield and since we are concerned here only with the organizational role that meaning plays in learning and recall. We shall, therefore, restrict ourselves to the latter problem.

A very interesting study was conducted by Marks and Miller (1964). The latter found that grammatical and meaningful sentences are learned most rapidly while unsyntactic and meaningless sentences are learned least rapidly. Interestingly, they also found that there was no difference in rate of learning between the meaningless but grammatical sequences and the meaningful but ungrammatical sequences with both these curves falling midway between the other two curves.

These findings would suggest that while meaningfulness is an independent factor in organization, its effect is not larger (nor smaller) than the effect of grammaticality. This interpretation, however, contradicts the point made by Johnson (1968) and discussed in this chapter that the effect of meaningfulness has consistently shown itself to be larger than the effect of grammaticality. The problem seems to stem from the fact that the meaningful but unsyntactic sequences used by Marks and Miller are not in reality meaningful - at least not immediately. These sequences were constructed by scrambling the order of words taken from meaningful sentences. They are hence anagram strings and meaning cannot be derived from them except after a certain amount of thought. It is thus difficult to assess the effect of meaningfulness from the results of the Marks and Miller study. It should be noted, furthermore, that the idea behind this study assumes that psychological meaning is a dichotomous variable - either verbal material is meaningful or either it is not. But this might not necessarily be the case. Some materials might be less meaningful than others. If this is the case, then it is very possible that some grammatical sentences are "more grammatical" than meaningful sentences are meaningful (or vice-versa).

Another study to be concerned with the effect of semantic constraints has been that of Epstein, Rock and Zuckerman (1960). The latter found that lists of nouns were learned more readily than were lists of equally familiar conjunctions, and that list of conjunctions

were not learned more readily than were lists of prefamiliarized nonsense syllables. This would argue, of course, that the effect of meaningfulness in learning is a significant independent factor. The authors mentioned, in addition, that meaningfulness "makes possible organization or conceptual unit formation."

Other studies (e.g., Epstein, 1961, 1962; Deese and Kaufman, 1957) have also dealt with the effects of semantic constraint. The typical procedure in these experiments was to compare the learning of both semantically meaningful and syntactically correct strings with meaningless but syntactic strings and also with random strings. The results usually showed that the first kind of sequence was learned the most rapidly, the third kind of sequence the least rapidly, and the second kind of sequence the most rapidly after the first.

The Process of Encoding

It has been demonstrated (e.g., Miller 1956a) that performance on a memory task is more related to the number of units to be retained than to the information load carried by each individual item. It has also been shown (see Hall, 1966) that recall of letters can be substantially increased if the letters are arranged into words. To explain these facts Miller (1956b) has suggested an organizational process he calls encoding or recoding. This process involves coding within the immediate memory span the material into units or "chunks".

If, for instance, a S is asked to retain a set of verbal items, he does so by retaining a symbol (or a few symbols) representing the entire set. At recall the S remembers the symbols and decodes it to produce the specific items. The maximum number of chunks that can exist in immediate memory, Miller contends, is seven, but the amount of material that can be recalled can be increased by building larger and larger chunks (i.e., by combining smaller chunks into larger ones).

The recoding process is illustrated in an experiment by Miller (1956b). In this experiment Ss's task was to recall a random series of zeros and ones by representing sets of three digits by any number from 0 to 7. The Ss's memory span for the binary digits was subsequently tested and was found to be greater than it was before they had learned this recoding process or scheme. The results also revealed that recall increases the more the recoding scheme is learned. Support for Miller's chunk hypothesis has come from Murdock (1961) and Cohen (1963). Cohen (1963) presented singly to one group of Ss a set of 20 unrelated words which they had to recall after a single presentation of the entire list. Another group of Ss was presented 70 unrelated words which were arranged in 20 categories. If the chunk hypothesis was correct, related words should be given a new name or label, that is, should function as a single unit in memory, while unrelated words should not (i.e. the chunk in the list of unrelated words should be a word). These predictions were borne out. There was no significant difference in the number

of chunks recalled in either list. These results, then, argue very much in favor of the interpretation of the category clustering phenomenon given by Bousfield (1953) and illustrated in Figure I - that recall of words in clusters occurs because these words are instances of a common concept.

Miller's (1956c) contention that memory is limited by the number of chunks that can be recalled has also received support. Tulving and Patkau (1962) showed that in the free recall of different orders of approximation to English sequences there was little change in the number of chunks recalled (defined as sequences of two or more words recalled in the order of presentation) and that there was an increase in the average size of the chunks recalled. In another interesting study, Lachman and Tuttle (1965) found that the principal influence of structured or organized material in a learning situation was that of increasing the efficiency of the method of storing the material during retention.

Although considerable evidence has been found for Miller's hypotheses, there is still a vast amount of knowledge to be gained in that area. How general is this concept of chunk or how general are we supposed to make it ? If a subset in a set of sentences is recalled in a sequence, is this subset also supposed to constitute a chunk ? If so, it follows that there must have been some relationship(s) between the sentences in the subset. What, then, are the kind of relationships that sentences (or propositional information, for that

matter), have to have in order to form chunks? Are some relationships that sentences have to each other more "efficient" as bases for structure or organization than others? (This, as has been pointed out, is one of the questions that this study attempts to answer). Furthermore, will the nature of the chunks be solely a function of the stimulus material the S is confronted with? Or is it also a function of some property of the mind? That is, do Ss have some "natural preference" for certain kinds of chunks?

Subjective Organization

As it was mentioned in the discussion on clustering phenomena, control lists of unrelated words were used as a contrast to demonstrate the recall advantage found in lists of clustered or related words. It has been shown, however, that even in the recall of lists of unrelated words clustering does occur, (in spite of attempts by the experimenter to thwart the presence of an organizational base within the list). This type of clustering in lists of unrelated words called subjective organization, refers to the tendency of recalling pairs of unrelated items consistently on repeated trials (with presentation having at all times been randomized). The idiosyncratic habits of Ss, it seems, are sufficient to provide some kind of an organization.

Subjective organization can be illustrated experimentally in a study by Tulving (1962). The latter presented a list of 16 disyllabic nouns to Ss for 16 trials, using on each trial a different order of

presentation. The S's task after each presentation was to recall as many words as he could. Tulving found a positive relationship between number of words recalled and number of trials. More importantly, however, he found that Ss had a significant tendency to recall words in the same order on different trials. In addition this tendency increased with repeated exposures to the stimulus material. A related study was conducted by Bousfield, Puff, and Cowan (1964). Ss in their experiment had to memorize a list of ten words, the latter having zero interitem associative strength according to the Russell and Jenkins (1954) norms. The experimenters found that intertrial repetitions (ITR) increased over trials and that a significant agreement among Ss in the final order of recall of words occurred, this order having no relationship to the frequency of usage of the words.

Results paralleling the ones outlined above have been obtained by many investigators - Bousfield, Berkowitz and Whitmarsh, 1959; Ehrlich, 1965; Tulving, 1964; Seibel, 1965. The question which emerges out of this research is what accounts for the increased subjective organization that occurs over trials in free-recall experiments. Mechanic (1964) has tried to discover whether repetition of the presented item is involved in this relationship. He had two groups of Ss learn 24 pronounceable trigrams, each trigram being presented at the rate of 11 sec. each. The first group had to pronounce each item continuously until the next one was shown, while the second group was left free to do what they wished during the interitem intervals. When

the results were calculated, it was found that the second (no-repetition) group recalled significantly more trigrams than the first group. Similar findings were obtained by Glanzer and Meinzer (reported by Tulving, 1968) who used a procedure identical to that used by Mechanic (1964). In this study also, Ss who did not have to repeat the items showed better recall than those who had to. Overt repetition, then, does not seem to be involved in subjective organization and probably even prevents Ss from organizing the material.

Other investigators have suggested hypotheses other than intertrial repetitions to account for the positive relationship between subjective organization and number of trials. Tulving (1962, 1964, 1966) has submitted that this relationship means that interitem associations are strengthened as a consequence of repeated presentations and recall of the items. Another suggestion was made by Carterette and Coleman (1963, reported by Tulving 1968). This suggestion was that increases in subjective organization are due to or follow increments in recall.⁴ Still a third interpretation was made by Tulving in 1968. This was that " . . . both increments in recall and increments in organization are parallel but otherwise unrelated manifestations of a common underlying process and that one has no more effect on the other than the second has on the first." Which one of these interpretations is the correct one is, of course, a matter to be settled by further empirical investigation. It should be noted, however, that most of the experimental evidence gathered in

the areas of research we have reviewed - clustering, sequential dependencies, grammaticality, encoding - show that an increase in the degree of organization results in an increase in amount recalled. Therefore, that increments in organization follow increments in recall or that both these events are independent of each other are positions that seem somewhat contrary to the facts. What seems probable is that recall is in part a function of organizational factors.

Kernel Sentences and Learning

A totally different approach to the effects of contextual constraint or organization on learning has been to study the effect of the kernel of a verbal message on learning. The notion of kernel sentence is aptly elaborated by Miller (1962). A kernel sentence is an active, affirmative, declarative sentence of the subject-predicate form such as "The typist has copied the paper", "The boy has hit the ball", etc. The subject always refers to an object or an individual thing and the predicate to a property or some characteristic of that object. Thus a kernel sentence informs us of the relationship between an object and an event or another object (i.e., the boy and the ball or the boy and hitting the ball).

Mehler (1963) has conducted an interesting study in this area.

Using eight kernel sentences he generated a total number of 64 by using seven transformations of each of the original kernel sentence. The transformations were negative, passive, interrogative, negative-passive, negative-interrogative, passive-interrogative, and negative-passive-interrogative. To each group of Ss he presented a recording of a set of eight sentences, the sentences in the set representing no sentence and no transformation more than once. The set of sentences was presented for five successive trials and after each presentation the Ss attempted to recall the material. Mehler found that the kernel sentences were significantly easier to learn than any of the others and, furthermore, that the greater number of errors were syntactic ones, (not omissions, inventions and the like). These results were interpreted to mean that Ss remember the general sense of a sentence by "analyz(ing) it syntactically and encod(ing) it as a kernel sentence . . . plus some "mental tag" that indicates the . . . transformation".

Miller (1962) also makes this type of interpretation. He asserts : "The hypothesis is that what people remember is the kernel sentence, but that when you ask them to recite the original sentence exactly, they supplement their memory of the kernel with a footnote about the syntactic structure."

Mandler and Mandler (1964) seem to have obtained an indirect confirmation of this hypothesis. They examined serial position effects

for the acquisition of the primary communicative content of sentences. (such as "Girls jumped rope" in a sentence like "The girls jumped rope for one hour after school both yesterday and today"). Their results suggested that serial learning of English sentences proceeds differently than rote learning of unrelated words. In the former what words are recalled is determined by which ones make up the core meaning, and not by primacy and recency effects as in rote serial learning. In other words, central phrases such as "Girls jumped rope" are retained more readily than non-central phrases such as "for one hour".

CHAPTER II

THE PROBLEM

As can be noticed in the preceding review, most of the work on organizational factors has restricted itself considerably with respect to the nature of the problems it has dealt with. Either it has used words (and scored in terms of them), or else it has been concerned with the organizational effects introduced by factors which are somewhat "atypical" - e.g., grammaticality vs. non-grammaticality, meaningfulness vs. meaninglessness. It is said atypical because it is not likely that the S who, in the everyday common environment, is faced with the task of learning a great number of meaningful and grammatical sentences will be using to any considerable extent grammatical signals or syntax to remember the material. More probable, is the event that the semantic relationships between these meaningful and grammatical sentences (e.g., temporal, causal, etc.) serve as bases (not necessarily consciously) for the organizational processes that might occur.

Furthermore, the work on organizational factors has neglected a (perhaps much more typical) area of investigation, namely the nature of the organization of both meaningful and syntactic sentences, or more precisely, the exact role(s) played in organization by semantic features imparted by these sentences (i.e., what the sentences say, propose or mean). Thus, although work using lists of words and

unmeaningful and ungrammatical sequences is necessary if all the factors in organization are to be known, research directed at the discovery of organizational variables occurring in the learning of grammatical, meaningful sentences is also necessary.

This study, then, is concerned with the organization of both semantically meaningful and syntactically correct sentences, or more generally, with the organization of propositional information. It is thought that a major variable governing the organization of such verbal information is the meaningful relationships that exist between the pieces of the information - relationships which are in turn based on semantic features imparted by the sentence (e.g. the event described, the time or date involved in the information, the person or individual referred to, etc.) The term proposition, in consonance with tradition, refers to a declarative sentence in which anything whatsoever is affirmed or denied.

Several other factors, besides the ones mentioned, point out the need for research of the kind undertaken here. First, the study of organization using words does not allow for the appearance of larger units of organization that might possibly exist (e.g., kernel sentences). Miller (1962) cites an experiment which supports the idea of such larger units. This study does not restrict the unit of organization to a single word, since it uses sentences (nor does it score for recall in terms of words). A point related to this matter derives from the question of whether a meaningful but ungrammatical

sequence of words is actually meaningful. Such a sequence is constructed by scrambling the order of English words making up a sentence : "Buy a did he pair not shoes of", for example. (From "He did not buy a pair of shoes"). But the scrambled sequence is not really meaningful, we do not know what it says, at least not immediately. Semantic constraint, or meaning therefore, does not derive from a single component or word but from the entire unit of words. The latter unit, then, can be a unit of organization.

Finally, as has been observed, there are many types of organizations that can be employed to facilitate learning or recall. It is thus necessary to determine the order of predominance, if any, of the different kinds of organizations. This is part of the intent of the present investigation.

The present study

This investigation is concerned with the organization of verbal propositional information. It seeks to determine (1) the predominant forms of organization of such information and (2) the effects of different kinds of organization of this information on learning.

By the term organization we are referring to the arrangement or pattern, in storage, of the units of information. It is thought

that information is stored as units and that these units are encoded in some way in the brain. Since it is possible for units to have several types of relationships between one another (e.g., verbal items can have semantic and phonetic relationships, or both), several ways in which these units can be arranged or patterned in storage are possible. Hence the question of the predominant forms of organization. Operationally, the kind of organization that has been involved in acquisition can be assessed from several output orders of the same items in a free recall situation.

The type of information that will be used in this study will be sets of factual sentences, each sentence containing the possibility of being related to another sentence on different bases. This point will be elaborated more fully in the subsequent discussion on the experimental design.

Two hypotheses have served to guide and to provide a framework for the present research. These are that :

1. the most common way to organize information is on the basis of causal relationships between the pieces or units of the information and such that, within this "causal structure", the pieces would fall into a "forward" (i.e., from beginning-to-end) temporal sequence, but that :
2. between these two ways to organize (causally and temporally),

the former takes precedence (i.e., is predominant) over the latter.

These hypotheses were arrived at from observation of both the writer's and other persons' way of organizing material when preparing for an examination, when writing an essay, and doing activities of this nature. It seems intuitively correct and logical that material that is logically organized and understood will be remembered more fully than material which is not. A S, for instance, who is studying the Russian revolution of 1917 will remember or "master" the material better if he perceives how one event gave rise to another rather than if he tries to blindly memorize these events without seeing the relationships between them. The advantage of saying that causal relationships can function as a basis of organization (i.e., govern the output order of recall) is that it can account for many phenomena of learning and recall and hence characterize the activities of the S in such a situation. It is doubtful, for instance, that the recall of the Russian revolution is governed by the strength of interitem associations. For although the name Lenin may have in the past occurred contiguously with the overthrow of 1917 (and been reinforced), there are many other events in this history that the S probably never heard of. Moreover, if there are some items that are strongly associated with one another, the reason for this in the first place is not necessarily past contiguity of occurrence with or without reinforcement, or some similar notion. In the case of learning a branch of mathematics for the first time an associationistic account of this process is even more useless. It is hardly conceivable

that the learning of the theory of numbers, for instance, is not based on at least some, if not all, of the S's logical thought processes.

By the term causal relationships we are referring to cause and effect relations - relations of which can exist between propositions. Consider the following sentences :

John and Mary graduated at exactly the same time. Although he searched thoroughly, John could not find a job in Reno. Thus one month after his graduation John went to Chicago where he thought more opportunities awaited him there. Mary was not so persistent, she left her home town one week after graduation. Two weeks later she found a pleasant and rewarding job.

There is a cause and effect relationship between certain propositions in the second and third sentences; one event (described by the second sentence) led to the other (described by the third sentence). It was because John could not find a job in Reno and because he thought that there were more opportunities in Chicago that he left for the latter city. There are other causal relations in the sentences which the reader will find upon inspection. The whole paragraph as it is presented is organized on a predominantly logical, thematic basis. Other ways to organize this paragraph, however, are possible. Using a forward temporal organization, the fourth sentence has to precede the third, since the event of Mary's leaving her home town (one week after graduation) temporally preceded the event of John leaving his (i.e., one month after graduation). Similarly, the fifth sentence has to come

before the third but after the fourth, since Mary found a job before John left for Chicago. Both a causal and forward temporal organization of this paragraph is not possible, however, since some of the events described, although they have a temporal relationship to one another have no cause and effect relationship (e.g., the events described by the third and fourth sentences). Thus according to our hypotheses a causal form of organization (i.e., the same one that is presented above) would be predominantly involved if a S had to retain this paragraph.

Turning now to the two experiments performed in this study, (and the hypotheses will become clearer after discussing them) the essentials of the design are as follows :

Experiment I

The first experiment was designed to test hypothesis 1, that is, whether a causal form of organization having in addition a temporal organization within it, is, in fact, the predominant form of organization. But this experiment (as well as the second one) also determines the effect of this organization and others on serial anticipation learning.

Three lists of exactly the same sentences but differing in the organization or sequential ordering of these sentences were devised. These lists are presented in Appendix A. The total number of

sentences was 12, six of which coherently described the developing concept of light, and six of which described the history of the treatment of mental illness. Each of the sentences contains the date or time of occurrence of the event(s) in question, the name(s) of the person(s) and locations that were involved in these events, and the event(s) themselves. In the first list, called the Causal and Temporal Within or CTW list, the first six sentences are the ones dealing with the concept of light and the last six sentences are the ones dealing with the theme of mental illness. In each set of six sentences there is a causal sequence as well as a forward temporal one. That is to say, the events in any two adjacent sentences in each set have a cause and effect relationship, or to put it differently, the event described by the second sentence in any pair of adjacent ones is a consequence of the event described by the first sentence in this pair. Furthermore, in each set, each successive event is temporally subsequent to the preceding one. As will be seen by a glance at the list the dates which are mentioned occur in this order : Time immemorial, 1704, 1750, late 18th century, 1803, 1840, for the theme of light. This type of temporal order was also used for the sentences concerning the history of mental illness.

In the second list that was used (called the Causal, not Temporal or C list) the first six sentences were also of one theme (the theme of light) and the last six sentences of another (the theme of mental illness). In each set of the sentences in this list, however, the sentences were not presented in a temporal order of any kind what-

soever. That is to say, the event described in one sentence was not temporally subsequent to the event described in the preceding sentence. The way the sentences were ordered was such that within each theme, each sentence had a cause-effect relationship with another sentence in the same theme - although, not always the adjacent one. The cause-effect relationships, of course, are derived from the content of the sentences.

In the third list (the subject or Sub list), the sentence that was chosen to follow another one, in a given pair, was the sentence in which was embedded the same individual(s) or subject(s) as in the preceding sentence. It will be noticed that the name of an individual involved in an event occurred twice in the list (in two sentences), once in a sentence concerned with the concept of light, and once in a sentence concerned with mental illness.⁵ Thus we have six pairs of sentences, each member a pair containing the same name as the other member, but each member, nevertheless, being about a different theme than the other. The sentences were presented such that the names of identical individuals occurred adjacently. This list, then, has no causal or temporal order; the themes alternate, and the organization is according to subject or individual. The third and fourth sentences, for instance, both contain the name Young, and the fifth and sixth sentences both contain the name Newton.

Each of three groups of Ss heard one of the three lists

twice on a tape-recorder. Immediately after the second presentation the method of serial anticipation was used to determine learning. Ss were told that they had to recall the sentences in the order they were presented on the recording, and that after they recall a sentence, it (or the correct one if their recall was erroneous) would be presented on the screen for them to read. After a sentence was flashed off, the screen was blank and at this point they were to anticipate the next sentence that they heard on the recording. Recall time was 30 sec. and sentence exposure time was 13 sec.

There were five trials of anticipation learning with no interval between trials. Amount of learning on each trial was determined by scoring for the number of phrases in any sentence that were correctly recalled. The sentences were divided into date or time of occurrence, names of individuals, names of locations, and proposition

The reasons for this method of division are discussed in Chapter III. Each phrase that was correctly recalled was given a check mark; a phrase was correct or incorrect according to certain criteria and these will also be discussed in the subsequent Chapter.

This experiment then allows comparisons between the learning of identical but differently organized propositional information. Since each group of Ss had to learn identical material that was organized in a particular way, one can truly speak of the effects of different organizations on learning. But can one speak of the order of predominance of the three organizations that were employed

if differences in amount of recall and rate of learning are found using these organizations ? As has been shown by many investigations, most of them reviewed in Chapter I, organization is a variable in learning and increases with repetition or trials. A higher recall score averaged over five trials and greater rate of learning obtained by one group of Ss must mean hence that the organization in question is capable of facilitating to a greater extent the learning of the material. That is, these results must mean that it is "more natural" (i.e., more of a tendency, if one is permitted to speak in this fashion for a moment) for the human mental functions to organize material in this particular way than to organize it in another way.

It might also be argued that this experiment would have been more complete if more than three kinds of organizations of the material were used. It would have been possible then to make more than three comparisons. It should be noted, however, that in Experiment II two organizations of the material were used that are different from any of the organizations involved in Experiment I. Therefore, we do, in fact, have more than three comparisons in the study.

Experiment II

The purpose of this experiment was to test the second hypothesis - i.e., to discover which of the causal or forward temporal organizations is superior or better facilitates recall and from which there would be more transfer on subsequent learning. Although the same two themes as

in the first experiment were used, the sentences themselves (eight in all) were slightly altered in order to fit one of the requirements of the experiment which was to have the possibility of manipulating the sentences into a temporal form of organization - something which could not be done with the sentences used in Experiment I. The sentences (presented in Appendix B), though, preserved the same approximate level of difficulty since the events described were essentially the same and were of a factual, non-motivational content.

In the first or Causal (C) list the first four sentences were about the developing concept of light and the last four sentences were about the changing treatment of mental illness. There was no temporal sequence in this list whatsoever. Within each set of sentences dealing with the same theme, however, each sentence had a cause and effect relationship (the notion of which was discussed in connection to Experiment I) with another sentence in that group - although, not always the adjacent one.⁵ By embedding phrases such as "because of (a previously described event or a previously mentioned name)", "as a result of . . ." in a sentence its causal relation to another sentence was effectively signalled; the nature of the sentences themselves also made clear to which other sentences they were causally related. Furthermore, there were only four sentences per theme and thus perception of the causal relationships between such a small number of sentences could not have been impaired. It was not possible to organize the sentences in a cause -- effect -- cause -- effect

... sequence since this type of sequence is also a temporal one.

The second or Temporal (T) list comprises the same sentences as in the C list and is organized such that each successive sentence (except the first) is temporally subsequent to the preceding one (i.e., the date or temporal message embedded in a sentence follows temporally the preceding date). The dates were chosen such that if one organizes the list in a beginning-to-end temporal sequence the sentences from each theme would alternate in their order of occurrence and would not follow any cause-effect cycle even though it might be within another theme. Thus this list has a forward temporal organization but no causal one. Figure 2 shows a conceptualization of the relationships that the sentences have to one another in the different lists used in the two experiments.

The method of division of these sentences into scorable units was identical to the one used in the first experiment : dates or temporal messages, names (of objects or locations) and propositions. Four groups of Ss were used. The first or CT group first listened twice to a tape-recording of the C list and immediately after the second presentation underwent four trials of serial anticipation learning. The Ss had each time to anticipate the sentence that comes next in the list during the time when there was no exposure on the screen. Immediately after the end of the fourth trial the Ss in this group listened twice to a tape-recording of the T list and after the second presentation underwent four trials of serial anticipation

FIGURE 2

CONCEPTUALIZATION OF SENTENCE SEQUENCES
 IN EACH ORDER OR LIST USED IN THIS STUDY
 (DATES OR TEMPORAL MESSAGES WERE EMBEDDED
 IN EACH SENTENCE)

CTW		C		SUB
cause (Time 1)	↓	effect (Time 2)		Person A (theme:light)
effect (Time 2)	↓	cause (Time 3)		Person A (mental illness)
cause (Time 3)	↓	cause (Time 1)		Person B (light)
effect (Time 4)		effect (Time 4)		Person B (mental illness)
.	.			.
.	.			.
.	.			.

T

Time 1 (theme : light)

Time 2 (mental illness)

Time 3 (light)

.

.

.

learning of the T list. The second or TC group went through the same procedure except in a reverse order : four anticipation trials of the T list and four anticipation trials of the C list (listening twice before each set of trials to a recording of the respective lists). The two other groups (IC and IT) were control groups. Each group first listened twice to a recording of irrelevant sentences concerning the evolution of civilizations of antiquity, underwent four serial anticipation trials of this material, listened twice to either the C or T list and finally, participated in four anticipation trials of one of the C or T lists. The scoring method was the same as that used in Experiment I.

The irrelevant sentences (shown in Appendix B) described how geographic and climatic factors were responsible for the development of ancient Mediterranean civilizations, and how these factors influenced, in turn, the style of life predominant in these societies. This theme has no relationship to either of the themes used in this investigation. The irrelevant sentences, however are of approximately the same level of difficulty and are written in the same style as the other sentences employed in this study. The method of dividing them into units and the method of scoring the amount of learning that was involved were also identical to the methods used with all the other sentences. The IT and IC groups are control groups. Their inclusion was necessitated by the fact that we wished to assess the effect of a prior task on the acquisition of a second task or, to put it more precisely, we wished to evaluate

the effect of prior causal learning on subsequent temporal learning and the effect of prior temporal learning on subsequent causal learning. One can conceive of the CT and IT groups as forming one proactive design, and the TC and IC groups as forming another proactive design. Within each design one can evaluate the effect of first-list learning by comparing the performance of the two groups on second-list learning. It would be helpful if the design for this experiment is visualized as follows :

		<u>Group</u>			
		<u>CT</u>	<u>TC</u>	<u>IT</u>	<u>IC</u>
Task or type of list	C	C	T	I	I
	T	T	C	T	C

The symbols cT and tC will be used to refer to performances of the CT and TC groups respectively on second-list learning (i.e., the T and C lists). The symbols iT and iC will refer to performances of the IT and IC groups on second-list learning, and C and T will refer to performances of the CT and TC groups respectively on first-list learning.

The predictions that obtain are the following :

- 1 a) Amount of recall for C should be higher than amount of recall for T (both calculated in terms of the same proportions of total amount of recall possible). (b) Similarly amount recalled for iC should be higher than that for iT . This expectation follows from our hypothesis that the causal organization is prepotent over the temporal organization.
- 2 a) Since the causal organization is supposedly superior to the temporal one, one should expect the previous learning of material causally organized to facilitate to a greater extent the subsequent learning of the same material temporally organized than the previous learning of material temporally organized to facilitate the subsequent learning of the same material causally organized. Hence, amount recalled for cT should be significantly greater than amount recalled for T by a greater amount than amount recalled for tC should be greater than amount recalled for C. Symbolically, if $cT - T = \Delta_c$, and $tC - C = \Delta_t$, $\Delta_c > \Delta_t$ and hence $cT - T$ (should be) $> tC - C$. (b) If there is no significant difference between amount of recall for iC and C as well as between amount of recall for iT and T, one should expect, by exactly the same reasoning,

that $cT - iT > tC - iC$.

It should be observed that the above comparisons are the ones that strictly follow from the second hypothesis, and that there are a number of other comparisons that will be made.

CHAPTER III

EXPERIMENT I

Method

The experiment took place in a large seminar-type room in which the acoustics were adequate and where, with the door closed, there was little noise or extraneous interference coming from the surrounding hallways. During the experiment the S was seated at a table facing a 50 x 50 in. screen with his back to the E (who was seated at another table). This was done in order that the S might not see any unintentional responses of the E (e.g., facial expressions) which might reinforce and hence affect the S's performance. A Kodak Carousel, Model AV-900 slide-projector was placed in the back of the room away from the S and by being connected to two Hunter, Model 1111 timers (which were themselves interconnected by appropriate wiring) was able to work automatically. Positive (black on white) slides were made of every sentence and the slides were put in the projector in such a way that there was nothing on the screen (just the illumination coming from the projector) in between each slide. The time when the screen was merely illuminated was recall time. In this way it was able to alternate between exposure and recall times.

The E had in front of him on the table the necessary number of copies of the list of sentences (divided up), one copy for each trial

run. The S could not see the sentences since he had his back to the E. No exchanges of any sort (except the utterance by the E of "Next" after a sentence was automatically flashed off) occurred between the S and the E during the experimental session.

Materials

Three lists differing in organization were constructed out of a set of identical, complex, factual sentences (12 in total). The lists are presented in Appendix A. In The CTW list, the first six sentences are about the developing concept of light and the last six sentences are about the history of the treatment of mental illness. Within each theme the sentences follow one another in a causal sequence as well as in a temporal sequence. These kinds of organizations were discussed in Chapter II and need no further mention here. In the C list the organization was merely causal : the sentences of one theme were not mixed with the sentences of the other, but the set of sentences dealing with the theme of light occurred before the other set of sentences. Within each set, however, there was no temporal order, the event described in a sentence was never (as judged by the date embedded) temporally subsequent to the event described in a preceding sentence. In the SUB list the ordering of the sentences was based on subjects or persons : the subjects in the first two sentences are "men", in the next two sentences the subject is the scientist Young, in the next two sentences it is Newton, and so forth. It was desired to see whether the Ss would use individuals as a basis for organization. Thus

this list is interspersed or randomized with respect to causal and temporal kinds of organizations since the name of each subject occurred once in a "light" sentence and once in a "mental illness" sentence, and had associated with it a different date in each of the pair of sentences.

Procedure

58 Ss; 31 female and 27 male, all enrolled in the Introductory Psychology course at the University of Alberta and native speakers of English, were assigned randomly to three groups. The first two groups contained 20 Ss each and the last group contained 18. Unequal distribution of the number of Ss was due to the fact that not all Ss who had signed up for it, came to the experiment.

Ss were tested individually in order to avoid inter-subject influences. Each S in the three groups was instructed to listen carefully to the sentences that would be played twice on the tape-recorder. He was additionally told that immediately after the second presentation he would undergo five trials of serial anticipation learning. This was explained to him by saying that after the second presentation of the information, he was to try and recall as much as possible of the sentence that he heard first, and that after a certain amount of time, this first sentence would come on the screen in order for him to study. This sentence would after some time on the screen be flashed off, at which point he was to attempt to recall the second sentence, and so forth

until the last one and for five trials. (A trial consisted of going through the entire list once). It was made certain that the S understood that he was to recall the sentences in the order they were presented. The detailed instructions to Ss are given in Appendix F .

The first (or CTW) group was played twice on a tape-recorder the CTW list of sentences. The second (C) and third (SUB) groups were played twice the C and SUB lists respectively. Immediately after the second presentation of the list, each group took five trials of serial anticipation learning, as described in the above paragraph, on the particular list that they heard, under exactly the same procedure.

The sentences were divided into dates or time mentioned (e.g., time immemorial; earlier); names of individuals, locations or objects (e.g., Witch Hammer); and propositions. The difference between propositions (defined in the third paragraph of Chapter II) and kernel sentences (as used by Miller, 1962) is that a kernel sentence is a proposition in the active, affirmative form. Thus it can be conceived that the sentences were partly analyzed into kernel sentences not always of the active affirmative form. The reason for this is that the sentences themselves were not of such a form.

There were several considerations for dividing the sentences in the manner that was used. Facts such as dates and names should be given credit if recalled correctly. Since there are many of them it is easy to forget or to get them confused. Furthermore, it is unrealistic to

expect, with the type of material that was given Ss to learn, that they would recall it or attempt to recall it in predominantly verbatim fashion. Inevitably, (and this is what, in fact, did happen) Ss would recall the sentences, in their own words (except for dates and names) and in different grammatical structures - while keeping the core meaning (i.e., the events) of the sentences unaltered. Hence the reason for partly dividing the sentences into propositions. The same reason was also the basis for allowing within a phrase 1) the occurrence of active and passive grammatical transformations; 2) the substitution of synonyms; 3) the permuting of words; and 4) the permuting of phrases within a sentence (e.g., Young, in 1803 instead of In 1803, Young as in sentence No 5).

The scoring procedure was based on recalling the content within the lines (i.e., the phrase) correctly. As the S spoke the E, having five copies of the sentences in front of him, one for each trial, marked a check above it if a phrase within a sentence was correctly reproduced according to the above-mentioned criteria. No partial credit was given if any deviation from the criteria set forth occurred. If this was the case no marks were made and the total number of points obtained in a trial were calculated by simply adding all the check marks that were made on the sheet.

There was no interval between trials. It was thought that an interval between trials might inform the S of the sentences that are first and last in the list. The only exchange that took place between

E and S during the trial runs was the E saying "Next" at the point in time when a sentence was flashed off and the screen merely illuminated.

Recall time was 30 sec. and sentence exposure time 13 sec. It was felt that longer durations for both recall and exposure might permit rehearsal (Tulving, 1962) and hence, attempts at verbatim reproduction on the part of all Ss to such an extent that this would not permit the possibility of obtaining recall difference between the groups. Shorter durations, on the other hand, were not advisable due to the complexity of the sentences.

A sample response sheet can be found in Appendix E.

Results

Analysis of the data obtained in this experiment (and the other one) was made by the use of the I.B.M. 360 computer in the A.P.L. programming language. For the Duncan's Multiple Range Tests which are shown in this section, the corresponding analyses of variance tests are given in Appendix C.

The overall means (summed across Ss and trials) for each group are shown in Table 1. A Duncan's New Multiple Range Test (Table 3) made to determine the significance of the differences between these means revealed that overall learning performance with the CTW list or organization was superior to both learning with the C and SUB organ-

TABLE I

MEAN NUMBER OF CORRECT RECALL OF PHRASES OF THE THREE CTW, C,
AND SUB GROUPS SUMMED ACROSS TRIALS AND S_S (OVERALL MEANS)

(EXPERIMENT I)

Experimental Condition	Mean (/67)
CTW	27.500 (41.05%)
C	18.700 (27.90%)
SUB	16.380 (24.35%)

izations. No significant difference, however, in overall learning performance was obtained between the SUB and C organizations.

Interestingly then, causal and subject-based forms of organization have very closely equal effects on serial anticipation learning (the C mean is slightly larger than the SUB mean). A causal form of organization, with a temporal structure within it, has, however, a much larger effect on learning, most probably because Ss use this type of organization more frequently or to put it in different terms because it is more prepotent. This is in accord with Hypothesis 1.

The Trials effect (Appendix C) was also significant ($p < .005$). This result, however, is not surprising since previous research has usually shown that learning and organization increases with trials or repetition.

The learning curves for the three groups are shown in Fig. 3. While all of them are linear, as is typical of serial learning curves, the CTW curve seems to become asymptotic after the fourth trial while the other two curves do not. This may be due to the fact that the CTW learning curve is much more elevated than the other two and Ss in this group may already be "saturated" and beginning to reach their maximum.

A Duncan's test (Table 4) was made to determine if there were any significant differences between the rate of learning of the three groups. The analysis of variance test for the slopes (Appendix C) made

TABLE 2

MEAN OF SLOPES OF LEARNING CURVE OF EACH S, SUMMED ACROSS S_S,

FOR EACH OF THE THREE EXPERIMENTAL GROUPS: CTW, C, SUB

(EXPERIMENT I)

Experimental Condition	Mean (7.67)
CTW	12.450 (18.60%)
C	9.750 (14.52%)
SUB	8.600 (12.82%)

Legend : • CTW Learning
 Δ C Learning (Experiment I)
 ⊙ SUB Learning

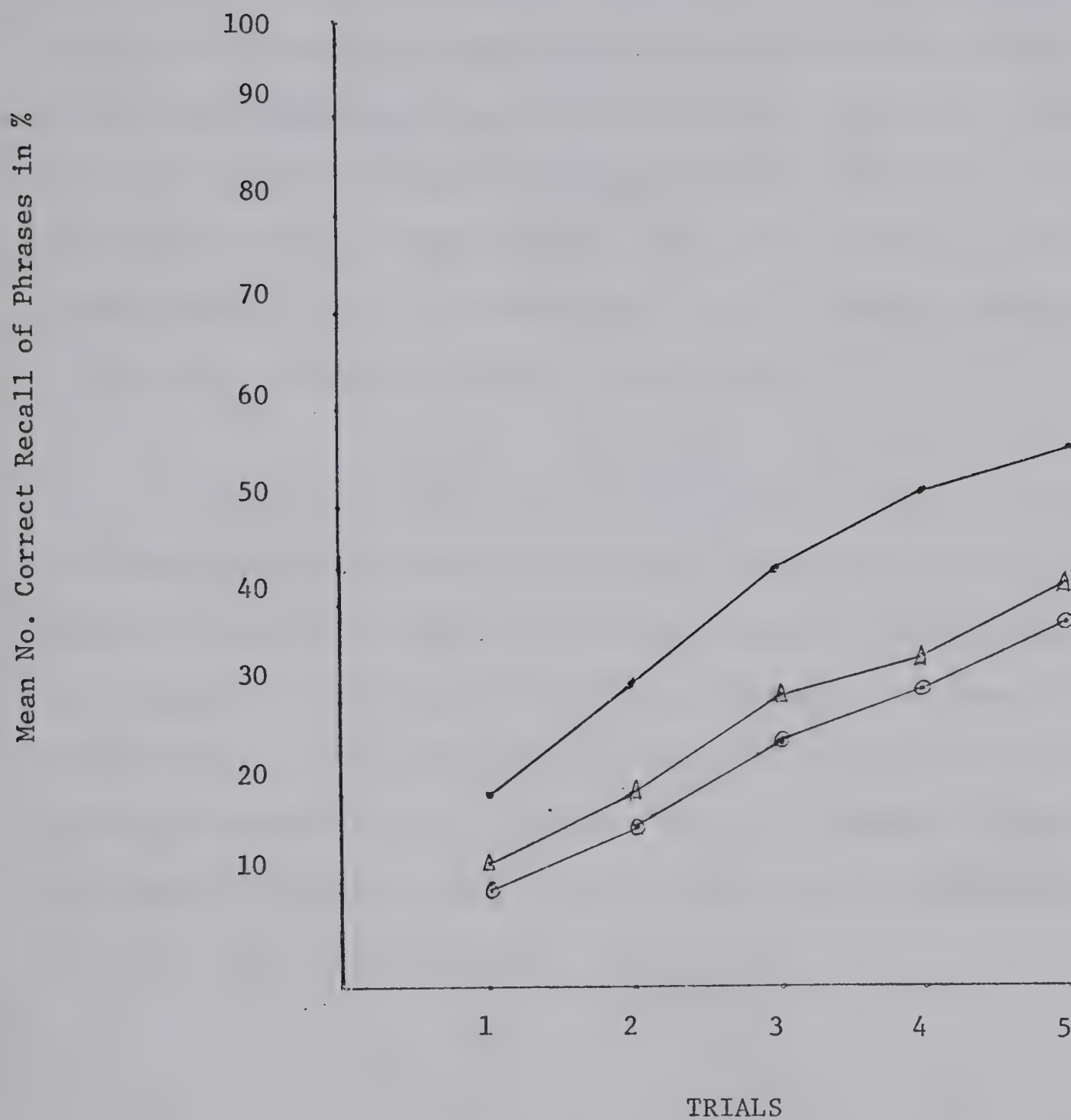


Fig. 3. Mean No. (in %) of Correct Recall of Phrases as a Function of Trials for the Three Experimental Groups. (Note slight divergence in slopes between the top and bottom two curves).

with the raw data showed a significant difference between these slopes, while the test made after the arcsine transformation showed no such difference. The Duncan's test reveals that for the SUB and C organizations there is no significant difference in rate of learning, and that the difference in slope between the C and CTW learning just misses from being significant at the 5% level. There is a difference in slopes, however, between learning the CTW and SUB lists. While the CTW curve seems to diverge from the other two, and these in turn appear almost parallel (Fig. 3) the CTW curve does not diverge enough from the C curve for a significant effect to be present.

The results obtained from the analysis of rate of learning of the three different groups are generally in consonance with those obtained from the analysis of the overall means of these groups. If we remember that CTW rate of learning just misses from being significantly different from C rate of learning, both results indicate that the CTW form of organization has a greater effect on learning or is more prepotent and that the SUB and C forms of organizations do not differ significantly in their effects on learning.

TABLE 3

DUNCAN'S NEW MULTIPLE RANGE TEST FOR UNEQUAL N'S APPLIED TO
THE DIFFERENCES BETWEEN THE 3 TREATMENT MEANS - THE ANALYSIS
OF VARIANCE (ON MEANS PER S AVERAGES OVER TRIALS) IS GIVEN

IN APPENDIX C*

(EXPERIMENT I)

Means	SUB 24.35%	C 27.90%	CTW 41.05%
	<u>(n=18)</u>	(n=20)	(n=20)

* An extension of Duncan's New Multiple Range Test for Unequal
n's can be found in Kramer (1956).

TABLE 4

DUNCAN'S NEW MULTIPLE RANGE TEST FOR UNEQUAL N'S APPLIED TO
 THE DIFFERENCES BETWEEN SLOPE MEANS FOR THE THREE EXPERIMENTAL
 GROUPS CTW, C AND SUB - THE ANALYSIS OF VARIANCE FOR THE SLOPE
 OF THE LEARNING CURVE FOR EACH S IS GIVEN IN APPENDIX C

(EXPERIMENT I)

	SUB	C	CTW
Slope Means	12.82%	14.52%	18.60%
	(n=18)	(n=20)	(n=20)

CHAPTER IV

EXPERIMENT II

Method

This experiment took place in the same room as Experiment I and under exactly the same conditions. The same equipment was also used and the method in all other respects was identical.

Materials

Three kinds of lists of sentences were used (all presented in Appendix B). The causal (C) and temporal (T) lists were constructed out of exactly the same set of eight sentences. In the C list the first four sentences dealt with the concept of light and the last four with the history of mental illness. Within each theme no temporal sequence was present, but there was a causal form of organization : the event described in a sentence was, according to the text, causally related to another event mentioned in the same theme. The T list was organized on a forward temporal basis : the event described in a sentence was temporally subsequent to the one described in the preceding sentence. Furthermore, the sentences of each theme alternated in their order of occurrence and did not follow a cause $\rightarrow$ effect cycle even though it might be within another theme. The third list that was used was the irrelevant or I list. It was made up of eight sentences which

related to the development and style of life of ancient Mediterranean civilizations, and was organized on a logical, coherent basis.

Procedure

64 Ss, 36 female and 28 male, were randomly assigned to four groups. The first two groups comprised 18 Ss each, and the last two groups 14 Ss each. Unequal distribution of the number of Ss was again due to some of them not coming to the experiment.

Ss were tested individually in this experiment also. In every group Ss were told that they were going to be played a set of sentences twice and that after the second presentation four serial anticipation learning trials of the sentences they heard were going to be given them. Following the fourth trial they were going to be played two more recordings (of some sentences) and had to undergo four anticipation trials of these sentences. The method of serial anticipation (i.e. what they had to do) was explained to Ss in the same way as in Experiment I. A trial consisted of anticipating and being exposed to on the screen, in order of presentation, each sentence in the list once. It was also made certain that Ss understood that they were to recall the sentences in their order of presentation. Detailed instructions to the Ss are found in Appendix F.

The first (or CT) group, underwent four anticipation trials on the C list and then four anticipation trials on the T list, each set of

trials being preceded by two presentations of the C and T lists respectively. The second (or TC) group was also given the same tasks but in a reverse order : two presentations of the T list, four anticipation trials of this list, two presentations of the C list and four anticipation trials of this list. The other two groups (IT and IC) were played the I list twice. Following this their learning was tested by the same method on four trials. At the end of the fourth trial, Ss in the IT group heard the T list twice, going through four anticipation trials on it afterwards, and Ss in the IC group heard the C list twice, going through four anticipation trials on it subsequently.

The method of division of the sentences as well as the scoring procedure were identical to those used in Experiment I. Recall and sentence exposure times were also 30 sec. and 13 sec. respectively. The sentences used in this experiment were very similar to the ones used in the first experiment.

A sample response sheet for Experiment II can be found in Appendix E.

Results

The data for this experiment was analyzed (also in A.P.L. programming language) as three 2 x 2 factorial designs. Each of these designs was subjected to analyses of variance tests (of both the raw

scores and their arcsine transforms); these tests were applied to

- (1) every response of all Ss in the group (four measures per S),
- (2) the means of learning performance for each S summed across trials (one measure per S), and (3) the slope of the learning curve for each S (one measure per S). For the first factorial design (iT, iC, tC, cT) the dimensions were : Prior learning of irrelevant sentences versus prior learning of identical sentences in either the T or C organizations; and learning of the T list, as second-list learning, versus learning of the C list as second-list learning. For the second factorial design (T, iT, C, iC) the dimensions were : Prior learning of irrelevant sentences versus no prior learning whatsoever; and organization T versus organization C. For the last design (T, C, tC, cT) the dimensions were: Prior learning of identical sentences (in either the C or T organizations) versus no prior learning whatsoever; and the TC order versus the CT order, or expressed differently, the transfer from the causal organization versus the transfer from the temporal organization. The analyses of variance for all these designs are shown in Appendix D, and the overall means (summed across Ss and trials) for each experimental task are shown in Table 5.

A t-test for the significance of the difference between the IT and IC groups in mean learning performance on the irrelevant sentences was made. For the significance of the difference between these two means: 59.98% and 60.04% respectively, t with 110 d.f. was 0.101 ($p > .3$) and thus these groups can be taken as matched with respect to retention capacity.

The findings that were relevant to the second hypothesis and the predictions deduced from it were the following :

The effects of the different types of organizations (C or T) on learning were found to be significantly different. The analysis of variance, shown in Appendix D, for the second factorial design (and the Duncan's Range Tests, Tables 8 and 9, Appendix D) both reveal that mean learning performance for C, which is 34.45%, is significantly higher than mean learning performance for T, which is 23.74%, at the 1% level. From the same analyses, the mean for iC (39.40%) was also found to be significantly superior to the mean for iT (29.60%) at the 5% level. Predictions 1(a) and 1(b), that causal learning would be superior to temporal learning are, therefore, confirmed.

Amounts of transfer from the causally and temporally organized sentences were also significantly different from one another at $p < .05$. This is shown through the B effect in the analysis of variance for the third 2×2 design (Appendix D) and in Table 6 where the percentages of transfer from each kind of organization are presented. Transfer from the causal organization can be greater than transfer from the temporal one by at least 50%. This result, then, confirms prediction 2(a) that facilitation by the causal organization would be greater than facilitation by the temporal organization, or that $cT - T$ (should be) $> tC - C$. Since the AB effect (analysis of variance for the first design, Appendix D) which refers to a comparison between the combined mean for iC and cT and the combined mean for iT and tC, is significant

TABLE 5

MEAN NUMBER OF CORRECT RECALL OF PHRASES FOR EACH SET OF FOUR TRIALS (C, cT, T, tC, iT, iC) EXCEPT IRRELEVANT ONES SUMMED ACROSS S_s AND THE FOUR TRIALS (i.e. OVERALL MEANS). ALSO MEANS OF SLOPES EACH CALCULATED OVER S_s FOR EACH TRIAL SET. (EXPERIMENT II)

TRIAL SET OR EXPERIMENTAL CONDITION	MEANS (/52)	SLOPE MEANS (/52)
C	17.958 (34.45%)	8.777 (16.86%)
cT	27.819 (53.50%)	4.305 (8.29%)
T	12.333 (23.74%)	7.930 (15.22%)
tC	26.694 (51.38%)	4.194 (8.05%)
iT	15.375 (29.60%)	6.042 (11.54%)
iC	20.517 (39.40%)	7.875 (15.13%)

TABLE 6

PERCENT OF TRANSFER ON THE TEMPORAL ORGANIZATION BY THE
CAUSAL AND ON THE CAUSAL ORGANIZATION BY THE TEMPORAL
(EXPERIMENT II)

Transfer from :	%
Causal ($cT - T/T \times 100$)	115.50
Causal ($cT - iT/iT \times 100$)	80.94
Temporal ($tC - C/C \times 100$)	48.49
Temporal ($tC - iC/iC \times 100$)	30.10

at the 5% level prediction 2(b) that $cT - iT > tC - iC$, is also confirmed.

The other findings were not directly relevant to the hypotheses, but they are still worth mentioning. Prior relevant learning has a significantly greater facilitative effect on subsequent learning than prior irrelevant learning. This is brought out in the analysis of variance of the first 2×2 design and in Duncan's Range Test (Table 7) where the means for iT and iC are significantly lower at $p < .05$ than the means for tC and cT . From the same analysis of variance, it is seen that the means for tC and cT , 51.38% and 53.50% respectively, are not significantly different from each other. The analysis of variance of the second design shows that prior irrelevant learning has no significant effect on subsequent learning; Duncan's Test (Table 8) also shows this same result. The analysis of variance of the third design (Appendix D), shows among other things, the unsurprising result that prior relevant learning, organization aside, significantly increases (at $p < .005$) subsequent learning; this is also shown in the Duncan's Test for that design (Table 9).

Two somewhat puzzling findings were obtained from the Duncan's Range Tests for the first and second designs (Tables 7 and 8, Appendix D). The first of these findings was the lack of any significant difference between the means for iT (29.60%) and iC (39.40%) - a result contradictory to the one obtained from the other analyses of the data - and the second was the lack of any significant difference between the

means for C (34.45%) and iT (29.60%). It was suspected that these effects might be due to heterogeneity existing between the variances in performance on the tasks analyzed by that test. It should be pointed out that it is reasonable to expect the variances for the tC and cT tasks to be significantly different from the variances for all the other tasks since the former are variance estimates drawn from a different population - one that has been affected by prior relevant learning. For the difference between the means for iT and iC, a t-test for heterogeneity of variance (i.e., for means from populations with different variances) was carried out. The iT mean (29.60%) was found to be significantly lower than the iC mean (39.40%) at the 5% level. t was 1.924 with 55 and 71 d.f. For the significance of the difference between the C (34.45%) and iT (29.60%) means, the same type of t-test was made, and t was found to be 2.095 and with 55 and 71 d.f. it is significant at the 5% level; the C mean is therefore significantly greater than the iT mean.

The analysis of variance for the slopes (averaged over Ss) of the cT, tC, iT, and iC learning curves (presented in Appendix D) shows that the cT and tC mean slopes, 8.29% and 8.05% respectively, are significantly lower than the mean iT and iC slopes, 11.54% and 15.13% respectively, at the 1% level. The Duncan's Range Test (Table 10, Appendix D) carried out on the differences between the slope means of these learning curves shows, however, that the tC and cT slope means are each significantly lower than the iC slope mean only. That the iT slope mean is not significantly larger than the tC and cT slope means may be

(EXPERIMENT II)

Legend : • CT Group (or curves for C and cT conditions)
 ⊕ TC Group (or curves for T and tC conditions)
 Δ IC Group (or curves for iC condition)
 ⊗ IT Group (or curves for iT condition)

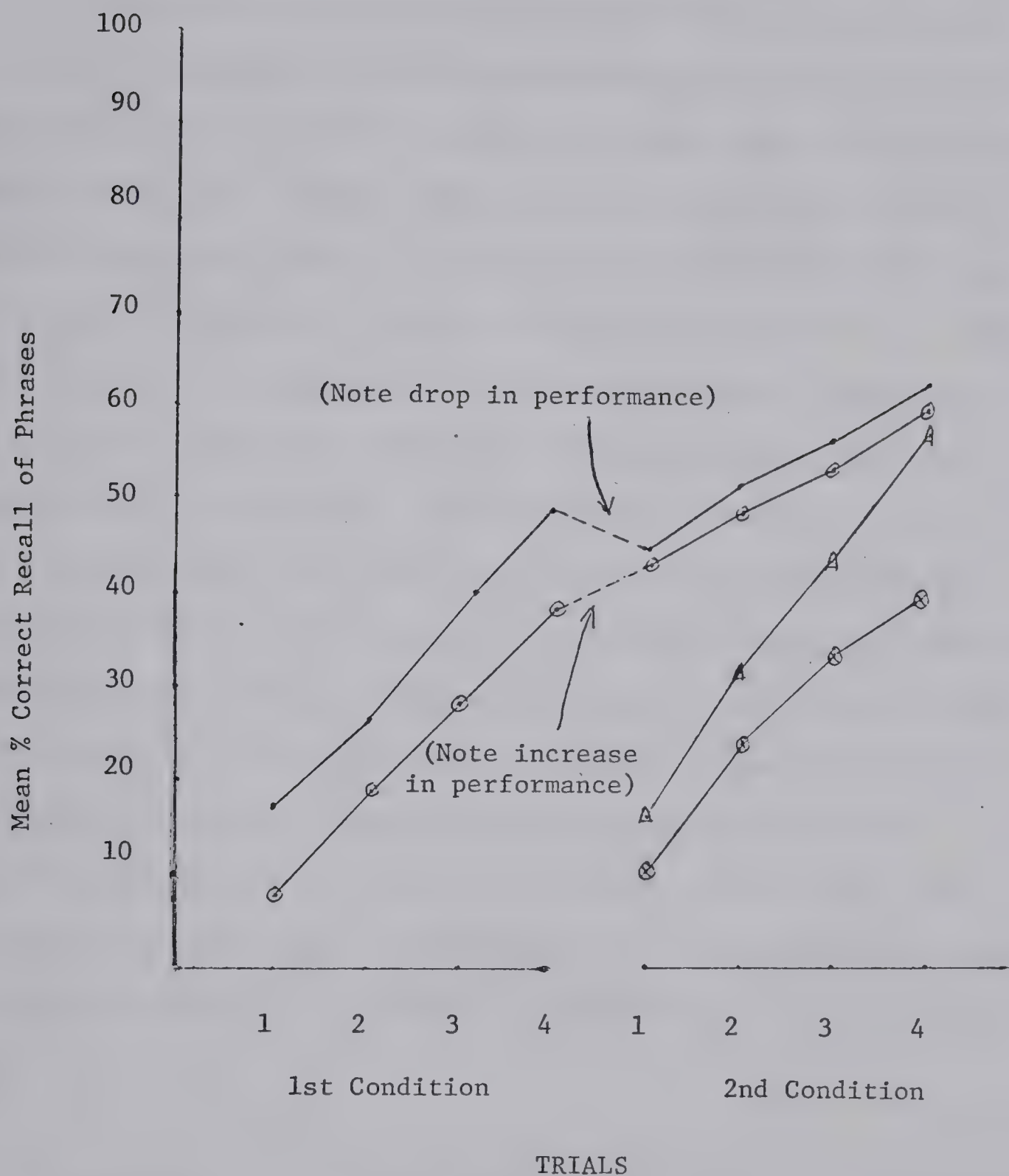


Fig. 4. Mean percent correct recall of phrases as a function of trials on both conditions for each group. (Learning curves for irrelevant sentences have been omitted).

due to the fact that the iT curve begins to reach an asymptote beginning at about the third trial, (see Figure 4).

For the slopes of the learning curves for conditions C, T, iC, and iT, no significant differences between any of them were found, as is shown in the analysis of variance for the slopes of these curves. Figure 4 shows that although these curves are differently elevated, their slopes do not appear to deviate to any considerable extent from one another. Expectedly, the slope analysis of variance for the third design (i.e., for conditions C, T, cT, and tC) revealed that the tC and cT rates of learning, 8.05% and 8.29% respectively, were each significantly lower than the T and C rates of learning, 15.22% and 16.86% respectively. This effect can also be seen in the Duncan's Test for the differences between the slope means in question (Table 11, Appendix D), and in Figure 4 where the cT and tC curves appear to have considerably different shapes than the C and T curves. It is not surprising that rates of learning for the cT and tC curves are significantly lower than rates of learning for all the other curves (except the iT one). Ss in conditions cT and tC received prior relevant learning and thus may be "saturated" and beginning to reach their maximum.

It should also be observed (Fig. 4) that there is a decrease in performance when the CT group changes from condition C to condition T, and that there is an increase in performance when the TC changes to the C condition or organization of the sentences. This, of course, supports

the hypothesis that the causal organization is "easier" than the temporal one.

Typically, it was also found that learning and organization increase with trials (see analyses of variance, Appendix D). It should also be noticed that there was no disagreement between the analyses of the results in terms of the raw data and in terms of the inverse sine transformation.

CHAPTER V

DISCUSSION

It is perhaps best to recapitulate the results briefly before entering a discussion of them.

The results of the first experiment suggest that Ss can use a causal form of organization, with a temporal sequence within that organization, more effectively than either a causal organization, with no temporal sequence within it, or an organization governed by subject or person with no cause-effect sequence in it. That is to say, with both a cause-effect and temporal relationship between sentences (or propositions or events) the Ss learn or retain more of the material than with the other types of relationships. Furthermore, no difference in learning performance was found between information that was causally organized and information that was subject-organized.

The important findings (and not all) of the second experiment were that : (1) a causal organization is easier than or "superior" to a temporal one (i.e., Ss learn more with a causal organization), and (2) that there is more transfer on, or greater facilitation of subsequent learning, by the causal organization than by the temporal organization.

The surprising (and interesting) effect obtained in the first experiment was the lack of significant superiority (in terms of

learning performance) of the causal organization over the subject-based organization. This effect is surprising because in the latter organization the sentences of each theme alternate in their order of occurrence in such a way that not only is there no logical, cause-effect relationship between any two adjacent sentences, but there is also no such relationship, for that matter, between any two sentences in a group of three and sometimes four sentences. The SUB list has hence no logical organization and no temporal organization either.

Two reasons can be put forth that might account for this finding :

- 1) It should be conceded that in the actual, everyday environment of the S events revolve to a large extent around people and that what people do are "thematically related" or more precisely causally related - at least most of the time. Thus the S, if he has to see how some events are generated and, hence, survive the everyday environment, must have a tendency to organize events around people. And since the action of individuals are inter-related, he must also to "understand what is going on" in his world, perceive such relationships or their nature. This means that both a causal and a "personal" (SUB) organization of the same material could be established in memory at the same time and that either one could be readily "translated" into the other. Hence the finding that the causal and personal organizations are equally strong.

2) The second and perhaps less theoretical reason is that, unlike the sentences in the C list of the second experiment, the sentences in the C list of the first experiment did not have embedded in them such phrases as "because of (a previously described event or name)", "due to . . . ", phrases which effectively signal the causal relation of an event to another event. Thus, causal relationships between sentences in the first experiment's C list might have been somewhat "obscured", at least, as compared to those between sentences in the second experiment's C list. This obscurity of the causal relationships between sentences in the C list of the first experiment might account for the obtaining of a mean for its learning that is not significantly larger than the mean for the learning of the SUB list. Perhaps a distinction should be drawn between lists of sentences which have embedded in them phrases like "due to", and "because of", and lists of sentences which do not have such embeddings, the organization of the latter lists being called "thematic".

If the above reasoning is correct then we should expect mean learning performance on the second experiment's C list - which has the above-mentioned type of phrases embedded in the sentences - to be significantly greater than mean learning performance on the SUB list. A t-test can be done to determine the significance of the difference between these two means. This has been done, but it should be noted that such a comparison (reported here informally) is dubious due to the content differences between the two lists and the fact that the

C list (second experiment) contains eight sentences and the SUB list twelve sentences - a fact which is important since recall has been found to be partly a function of list length (Dallett, 1964). The t-test is done because it is suggestive and gives hypothetical support to reason (2). Neglecting for the time being the list length variable, we find that for the difference between the means for the lists in question, $t = 1.690$ and with 160 d.f., the C mean (34.45%) is significantly larger ($p < .05$) than the SUB mean (24.35%). Although no conclusion can be drawn from such a finding, it nevertheless lends hypothetical support to reason (2).

The superiority or greater effect on learning of the CTW organization was expected. This superiority is very probably due to the fact that Ss learning the CTW list can, unlike other Ss, use two organizations (the causal and the temporal) to facilitate recall rather than one. The effect of the temporal organization on learning is not negligible since there can be as much as 48% transfer (Table 6) from it to subsequent learning. It might be that the effect of the temporal organization involves events (and other information) being associated with or "listed" under the appropriate temporal messages or dates.

It is more difficult at the present time, however, to arrive at clear notions of the nature of the psychological events present when causal forms of organizations take place. It should be noted, though, that organizations based on causal relationships might (and

our data does not inform us on this point) induce the occurrence in the S of more complex processes than either temporal or subject-based organizations. For before causal relationships can provide an organization, the S has to "understand" such relationships (i.e., see how a cause gave rise to its effect, perhaps have some sort of an image). But for the S to perceive or understand a causal relationship such a relationship must be true, or, at least, it must be "plausible". That is to say, that the causal relationship implied in a proposition like "He went to the restaurant because he was hungry", is more plausible than the causal relationship implied in a proposition like "He went to the restaurant because he was dirty".

Plausibility is thus a function of past experience in the environment, (people do not usually go to the restaurant because they are dirty), and causal relationships are hence partly a function of past experience, although probably not completely. Thus learning by using a causal organization is easier than learning by using a temporal organization (as the results of the second experiment show), possibly because in the former type of learning past experience is involved while in the latter type of learning it is not. Since experiences which are familiar to the S (most of which are past) are better understood by him, there is more "understanding" in causal learning than in other forms of learning which might be more like rote learning.

The results of the second experiment were in accord with the predictions deduced from the second hypothesis. The causal organization was found to be superior to the temporal one and more transfer or

facilitation on subsequent learning came from the causal than from the temporal organization. The latter effect can be interpreted as an increase in item accessibility (retrieval) due to the superiority of the causal organization. That is, with the causal organization items or elements might have been organized into units of a higher order or more complex forms of hierarchies (thus making retrieval easier) than might have units in the case of a temporal organization, possibly because causal organization involves past experience. It should be observed that causal relationships might themselves be the factors that act to build hierarchical arrangements or organizations of these units.

While the CTW form of organization has been found to be the one with which learning is greatest (greater than either with C, SUB or T organizations), on second thought, it should not be the most predominant or the most effective in learning. Considering three kinds of organizations that were manipulated in this study, the C, SUB and T organizations, one can obtain from all the possible different combinations of them (neglecting the permutations for the moment) seven different organizations : CSUBT (or all three organizations employed simultaneously), CSUB, CT (or what has been called CTW in this study to refer to both a causal and temporal organization), SUBT, C, SUB, and T. An interesting experiment would be one which compares learning performance with all these seven types of organizations; in this study only four different organizations were employed. Now if an experiment such as this one was carried out, it is clear that one would expect

the CSUBT form of organization to be the most effective, (three organizations must be more effective than either two or one). If, furthermore, the C and SUB organizations are equally effective or prepotent as the results of this investigation seem to suggest - results somewhat doubted by the E - then one would expect the CSUB organization to be superior to the CT organization and that organization to be superior to the SUBT organization. If this is the actual order of predominance or effectiveness on learning of these different kinds of organizations, only future research can tell for sure.

CHAPTER VI

SUMMARY AND CONCLUSIONS

Preceding research on organizational variables in acquisition has, in most instances, concerned itself with the incidental characteristics of verbal items and with the role of somewhat atypical and artificial mnemonic relations between items of verbal information. It has neglected what is thought to be a major variable in the organization of meaningful verbal material or information : the meaningful relationships existing between the parts of the information. The present study attempted, among other things, to show that inter-part relationships exercise an effect in the organization of meaningful verbal information. Since there can be several kinds of inter-part relationships, it was desired to determine the prepotencies or order of predominance of organizations based on different inter-part relationships. It was also desired to determine the effects of these different organizations on (serial anticipation) learning.⁸

It was hypothesized at the outset that verbal information presented in both a cause-effect and temporal sequence would be learned to a greater extent than information presented in just a causal or a temporal sequence, or a personal sequence (i.e., one based on the subjects or individuals connected to events). It was also thought that a causal organization would be prepotent to, or have greater facilitative effect on learning than would a temporal organization.

In Experiment I three groups of Ss were played twice on a tape-recorder a list of sentences. The sentences were in all cases identical except for the fact that their organization or ordering upon presentation differed. The first list had a causal organization, with a temporal organization within it, the second had a causal but no temporal organization, and the third had an organization based on the subject or person connected to a particular event. Following the second sentence presentation, Ss in each group underwent five serial anticipation learning trials on the list they heard (i.e., they had, by this method, to learn the sentences in the order they were presented). It was found that learning and rate of learning was greatest when the sentences were organized both causally and temporally, and that there was no significant difference in mean learning performance (averaged across Ss and trials) and learning rate between the other two groups.

It was suggested that the superiority or prepotency of the causal and temporal organization lied in the fact that two organizations embedded in each other have greater facilitative effects on learning than merely one organization. It was also mentioned that the equal effects on learning of the causal and subject-based organizations might be due to 1) the fact that in the real world events revolve, to a large extent, around people, and what people do is usually causally related, and 2) the fact that sentences in the causal list did not have embedded in them phrases such as "because of . . ." and "as a result of . . .", phrases which effectively signal causal relationships between sentences.

Experiment II tested the effect on learning of the causal and temporal organizations. The first group of Ss was played twice on a tape-recorder a list of sentences organized causally (but not temporally). Following the second presentation, they underwent four trials of serial anticipation learning. They were then presented with two recordings of the identical sentences which were this time organized temporally, and again underwent four trials of serial anticipation learning for this list. The second groups performed the same tasks but in reverse order : the temporal learning was performed first, and the causal learning performed second. In addition, two control groups were used. Each of these control groups had first to learn by serial anticipation (for four trials) a list of irrelevant sentences (after these were played twice on a tape-recorder). Following this task, they were played twice either the temporal or causal list and underwent four serial anticipation trials for one of these lists.

In both experiments the sentences were divided into phrases and recall on any given trial was calculated in terms of the ratio of the number of phrases correctly recalled to the total number of phrases in the list. Phrases were considered correctly recalled even if in a phrase 1) active and passive grammatical transformations occurred, 2) synonyms were substituted, 3) words within a phrase were permuted, and 4) phrases within sentences were permuted. A phrase correctly recalled was given one credit.

The major findings of the second experiment were that mean learning performance on the causally organized sentences was significantly superior to mean learning performance on the temporally organized sentences, that there was significantly more transfer from, or greater facilitation of subsequent learning by the causal organization than by the temporal one, and that prior relevant learning, organization aside, has a significant facilitative effect on subsequent learning. Suggestions regarding the prepotency or superiority of the causal organization, that is, what causal relationships do that temporal relationships do not or do less of, were given. Briefly, it was said that the increase in item accessibility occurring when causal learning is involved is partly due to causal learning involving (some features of) past experience.

While it was concluded that the causal organization, with a temporal organization within it, is prepotent over all the other organizations used in this study, and that the causal organization is superior to the temporal one, it was mentioned that other organizations should be tested in regards to their effects on learning. From the combinations that can be obtained from the causal, personal, and temporal structures, it is possible that some organizations have greater effects on learning than the ones employed in this investigation.

FOOTNOTES

1. The data discussed in this section was obtained for free recall in serial learning.
2. In a previous study, Cohen, Bousfield and Whitmarsh (1957) gathered normative data for the frequency of occurrence of items in response to 43 categories. High frequency taxonomic responses thus refer to instances of a category which occur with high frequency.
3. For a discussion of how approximations to English sequences are generated see Miller and Selfridge (1950) or Deese and Hulse (1967).
4. This position, incidentally, is the antithesis of that of Bartlett's (1932). In his enlightened book, Bartlett argued that the retention and recall of material is the result of our having reconstructed or schematized the essential details of the material. Schemas are internal organizations of experiences which function as active unities.
5. It was necessary to distort the truth of the sentences to meet the requirements of the experimental design. Ss were informed of this post-experimentally.
6. The event described in sentence No. 4, for example, is a consequence of the event described in sentence No 1.
7. For each analysis of variance test another one was made in arc sin transforms also in order to correct for heterogeneity of variance.
8. The organization that had the greatest effect on learning - our dependent measure - was viewed as the most prepotent (i.e., the most frequently used one). It was reasoned that an organization that has more facilitative effect on learning than another must be a more frequently used one.

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APPENDICES

APPENDIX A

LISTS OF SENTENCES USED IN EXPERIMENT I

Causal and Temporal Within (CTW) List

1. Ever since time immemorial/man has wondered about the nature of light./
2. In 1704,/ Newton/ in England/ thought that light is made up of particles./
3. In 1750,/ it is interesting to note,/Lebon/said if light consists of particles,/ why do we not feel the particles bouncing on our eyes./
4. Huygens,/ in the late 18th century,/ was unable to answer the scientist's question,/ but conceived light as consisting of waves;/ this view urged scientists to do their experiments./
5. In 1803,/ Young/ proved that light consists of waves/ when he passed a beam through two pinholes/ and this set up interference patterns/ like the waves of water./
6. Later,/ in 1840,/ the kind of waves that light is made up of was discovered by/ Fresnel/ and Arago./
7. In medieval times,/ the treatment of demented persons was not one of compassion/ and sympathetic listening/ but one of brutality/ and persecution./
8. Before the publication of the book/the Witch Hammer,/ Newton/ in 1720/ thought that mental disease was due to being perverse,/ witch-natured,/ and possessed of the devil./
9. This atmosphere continued to persist;/ in 1740/ Huggens,/ in Germany,/ published a book entitled/ the Witch Hammer/ which associated mental disorders with witchcraft/ and asserted that the insane should be tortured/ and burnt./
10. In 1780,/ Young/ questioned the witchcraft theory/ by saying if the insane are all witches/ why do the insane frequently perform witchcraft unsuccessfully;/ this was the beginning of the attack on the witchcraft theory./
11. The first step forward was made/ in 1793/ by Fresnel/ and Arago;/ the latter freed the insane from their chains/ and encouraged a sympathetic hearing of their troubles./

APPENDIX A (continued)

CTW List

12. Later,/ in 1810,/ Lebon/ continued the work of/ Fresnel/ and Arago,/ and fought for the establishment of mental hospitals./

APPENDIX A (continued)

Subject (SUB) List

1. Ever since time immemorial/ man has wondered about the nature of light./
7. In medieval times,/ the treatment of demented persons was not one of compassion/ and sympathetic listening/ but one of brutality/ and persecution./
5. In 1803,/Young/ proved that light consists of waves/ when he passed a beam through two pinholes/ and this set up interference patterns/ like the waves of water./
10. In 1780,/ Young/ questioned the witchcraft theory/ by saying if the insane are all witches/ why do the insane frequently perform witchcraft unsuccessfully;/ this was the beginning of the attack on the witchcraft theory./
2. In 1704,/Newton/ in England/ thought that light is made up of particles./
8. Before the publication of the book/ the Witch Hammer,/ Newton/ in 1720/ thought that mental disease was due to being perverse,/ witch-natured,/ and possessed of the devil./
6. Later,/ in 1840,/ the kind of waves that light is made up of was discovered by/ Fresnel/ and Arago./
11. The first step forward was made/ in 1793/ by Fresnel/ and Arago;/ the latter freed the insane from their chains/ and encouraged a sympathetic hearing of their troubles./
3. In 1750,/ it is interesting to note,/ Lebon/ said if light consists of particles,/ why do we not feel the particles bouncing on our eyes./
12. Later,/ in 1810,/ Lebon/ continued the work of/ Fresnel/ and Arago,/ and fought for the establishment of mental hospitals./
4. Huggens,/ in the late 18th century,/ was unable to answer the scientist's question,/ but conceived light as consisting of waves;/ this view urged scientists to do their experiments./
9. This atmosphere continued to persist;/ in 1740/ Huggens/ in Germany,/ published a book entitled/ the Witch Hammer/ which associated mental disorders with witchcraft/ and asserted that the insane should be tortured/ and burnt./

APPENDIX A (continued)

Causal, not temporal (C) List

1. Ever since time immemorial/ man has wondered about the nature of light./
5. In 1803,/ Young/ proved that light consists of waves/ when he passed a beam through two pinholes/ and this set up interference patterns/ like the waves of water./
2. In 1704,/ Newton/ in England/ thought that light is made up of particles./
6. Later,/ in 1840,/ the kind of waves that light is made up of was discovered by/ Fresnel/ and Arago./
3. In 1750,/ it is interesting to note,/ Lebon/ said if light consists of particles,/ why do we not feel the particles bouncing on our eyes./
4. Huggens,/ in the late 18th century,/ was unable to answer the scientist's question,/ but conceived light as consisting of waves;/ this view urged scientists to do their experiments./
11. The first step forward was made/ in 1793/ by Fresnel/ and Arago;/ the latter freed the insane from their chains/ and encouraged a sympathetic hearing of their troubles./
7. In medieval times,/ the treatment of demented persons was not one of compassion/ and sympathetic listening/ but one of brutality/ and persecution./
9. This atmosphere continued to persist;/ in 1740/ Huggens,/ in Germany,/ published a book entitled/ the Witch Hammer/ which associated mental disorders with witchcraft/ and asserted that the insane should be tortured/ and burnt./
8. Before the publication of the book/the Witch Hammer,/Newton/ in 1720/ thought that mental disease was due to being perverse,/ witch-natured,/ and possessed of the devil./
12. Later,/ in 1810,/Lebon/ continued the work of/Fresnel/ and Arago/ and fought for the establishment of mental hospitals./
10. In 1780,/Young/ questioned the witchcraft theory/ by saying if the insane are all witches/ why do the insane frequently perform witchcraft unsuccessfully;/ this was the beginning of the attack on the witchcraft theory./

APPENDIX B

LISTS OF SENTENCES USED IN EXPERIMENT II

Causal, not Temporal (C) List

1. In 1803,/Thomas/Young,/ because he was skeptical of the ideas of/Newton,/attempted to prove that light consists of waves/ by passing a beam through two pinholes/ and showing that it set up interference patterns/ like the waves of water./
2. Before the experiment of/Young,/ in 1704 precisely,/ Newton/ having shown that light travels in a straight line/ thought that light might, therefore, consist of particles./
3. However, in 1740,/ a scientist said if light consists of particles/ why do we not feel the particles bouncing on our eyes;/ although this question was ignored,/Young/ was nevertheless urged to do his experiment./
4. Thus by 1830,/ the wave theory of light came to be accepted/ not only because of the experiment of/Young/ but also because of the one by/Fresnel/ and Arago/which had conclusively shown that light is made up of waves./
5. In 1793,/Philippe/Pinel/ disgusted with the way the insane were treated,/revolutionized their treatment/by freeing them from their chains,/and establishing a more humane treatment./
6. Before this,/ in 1350,/ the mentally disturbed were burtally treated/because it was thought that mental disease was due to being perverse/and possessed of the devil./
7. This idea was taken so seriously, that/in 1710/ a book appeared entitled/the Witch Hammer/which associated mental disorders with witchcraft./
8. But by the 1820's however,/Dorothea/Dix,/ as a result of the work of/Pinel/ fought for a more understanding approach to mental disorders./

APPENDIX B (continued)

Temporal, not Causal (T) List

6. Before this,/ in 1350,/ the mentally disturbed were brutally treated/ because it was thought that mental disease was due to being perverse/ and possessed of the devil./
2. Before the experiment of/Young,/ in 1704 precisely,/Newton/ having shown that light travels in a straight line/thought that light might, therefore, consist of particles./
7. This idea was taken so seriously, that/in 1710/ a book appeared entitled/the Witch Hammer/which associated mental disorders with witchcraft./
3. However, in 1740/a scientist said if light consists of particles,/ why do we not feel the particles bouncing on our eyes;/although this question was ignored,/Young/was nevertheless urged to do his experiment./
5. In 1793,/Philippe/Pinel/disgusted with the way the insane were treated,/revolutionized their treatment/by freeing them from their chains,/ and establishing a more humane treatment./
1. In 1803,/Thomas/Young,/because he was skeptical of the ideas of/ Newton/attempted to prove that light consists of waves/by passing a beam through two pinholes/and showing that it set up interference patterns/like the waves of water./
8. But by the 1820's however,/Dorothea/Dix,/as a result of the work of/Pinel/fought for a more understanding approach to mental disorders./
4. Thus by 1830,/the wave theory of light came to be accepted/not only because of the experiment of/Young/but also because of the one by/Fresnel/and Arago/which had conclusively shown that light is made up of waves./

APPENDIX B (continued)

IRRELEVANT SENTENCES

1. Ancient civilizations developed in regions around/the Mediterranean Sea/primarily because of geographical/and climatic factors./
2. It was the Nile's waters/that made possible the growth of civilization/in Egypt./
3. Similarly, the rivers Euphrates/and Tigris/greatly made possible the development of agriculture/which was the economic foundation of/ Mesopotamian Civilization./
4. In Greece,/the nature of the land was mountainous/and this caused the development of isolated/villages/and city-states./
5. The climate which was mild/encouraged open-air life/and a lot of time was spent out of doors,/more than in other countries./
6. Men met their friends outside for pleasure/and business/and entertainment was usually enjoyed in open-air theatres/and arenas/.
7. In Athens,/assemblies/and courts met in the open/and at Rome/ trials were held in/the Forum./
- 8/ All this stimulated social intercourse/and community life./

APPENDIX C
ANALYSES OF VARIANCE FOR EXPERIMENT I
ANALYSIS OF VARIANCE FOR DATA OF EXPERIMENT I WITH 5 REPEATED
MEASURES FOR EACH S, AND 3 TREATMENTS, (n = 20, 20 and 18 Ss FOR EACH TREATMENT)

RAW DATA					USING ARCSIN TRANSFORMATION				
Source of Variation	Degree of Freedom	Sum of Squares	Mean Square	F	Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Treatments (Organizations)	2	6629.08	3314.54	11.35**	Treatments (Organizations)	2	132.64	66.32	11.11**
Error(a)	55	16060.19	292.00		Error(a)	55	328.21	5.97	
Trials	4	16396.18	4099.05	261.78**	Trials	4	327.66	81.91	312.64**
Treatments x Trials	8	376.23	47.03	3.00**	Treatments x Trials	8	3.16	0.39	1.49 (p> .1)
Error(b)	220	3444.80	15.66		Error(b)	220	57.64	0.26	
Total	289	42906.49			Total	289	849.27		

** - p < .005

APPENDIX C (continued)

ANALYSIS OF VARIANCE FOR MEANS PER S SUMMED ACROSS TRIALS (EXPERIMENT I)

RAW DATA					USING ARCSIN TRANSFORMATION				
Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F	Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Treatments	2	1325.81	662.90	11.351*	Treatments	2	24.79	12.397	11.068*
Within Groups	55	3212.04	58.40		Within Groups	55	61.60	1.120	
Total	57	4537.85			Total	57	86.40		

* - p < .005

ANALYSIS OF VARIANCE FOR SLOPE OF LEARNING CURVE FOR EACH S WITH THREE TREATMENTS (EXPERIMENT I)

RAW DATA					USING ARCSIN TRANSFORMATION				
Source of Variation	Degree of Freedom	Sum of Squares	Mean Square	F	Source of Variation	Degree of Freedom	Sum of Squares	Mean Square	F
Treatments	2	156.23	78.12	3.942*	Treatments	2	0.94	0.47	1.464
Within Groups	55	1089.90	19.82		Within Groups	55	17.65	0.32	(p > .1)
Total	57	1246.13			Total	57	18.59		

* - p < .05

APPENDIX D

ANALYSES OF VARIANCE FOR EXPERIMENT II

ANALYSIS OF VARIANCE OF DATA OBTAINED WITH TRIAL SETS cT, tC, iT, iC

FROM EXPERIMENT II

RAW DATA				ARCSIN DATA					
Source	D.F.	SS	MS	F	Source	D.F.	SS	MS	F
A (prior learning of irrelevant vs. identical sentences)	1	5461.20	5461.20	21.92**	A	1	151.56	151.56	21.34**
B (Second-list learning ofT vs. second-list learning of C lists)	1	254.25	254.25	1.02	B	1	7.02	7.02	0.98
AB	1	618.75	618.75	4.08*	AB	1	17.52	17.52	4.07*
Error(a)	60	14951.29	249.19	**	Error(a)	60	426.17	7.10	**
J (Trials)	3	4512.85	1504.28	202.499		3	127.13	42.38	204.51
AJ	3	576.38	192.13	25.86**	AJ	3	14.56	4.85	23.42**
BJ	3	38.26	12.75	1.72	BJ	3	0.75	0.25	1.20
ABJ	3	40.01	13.34	1.79	ABJ	3	0.70	0.23	1.13
Error(b)	180	1337.21	7.43		Error(b)	180	37.30	0.21	
Total	255	27790.21			Total	255	782.72		

* - p < .05

** - p < .005

APPENDIX D (continued)

ANALYSIS OF VARIANCE FOR MEANS PER SUBJECT SUMMED ACROSS TRIALS FOR
CONDITIONS cT, tC, iT, iC FROM EXPERIMENT II.

RAW DATA				ARCSIN DATA					
Source	D.F.	SS.	MS	F	Source	D.F.	SS	MS	F
A (Prior learning of irrelevant vs. identical sentences)	1	1365.29	1365.29	21.91**	A	1	36.32	36.32	21.72**
B (Second-list learning of T vs. second-list learning of C lists)	1	63.56	63.56	1.02	B	1	1.61	1.61	0.96
AB	1	154.68	154.68	4.08*	AB	1	3.94	3.94	4.07*
Error	60	3737.82	62.29		Error	60	100.32	1.67	
Total	63	5321.37			Total	63	142.18		

* -p < .05
** -p < .005

APPENDIX D (continued)

ANALYSIS OF VARIANCE FOR SLOPES OF LEARNING CURVE FOR EACH SUBJECT
IN CONDITIONS cT, tC, iT, iC. (EXPERIMENT II)

RAW DATA					ARCSIN DATA				
Source	D.F.	SS	MS	F	Source	D.F.	SS	MS	F
A (Slopes cT and tC vs.iT and iC)	1	132.03	132.03	8.45*	A	1	3.32	3.32	7.85*
B(Slopes cT and iT vs. tC and iC)	1	13.34	13.34	0.85	B	1	0.19	0.19	0.45
AB	1	17.01	17.01	1.08	AB	1	0.30	0.30	0.71
Error	60	937.45	15.62		Error	60	25.37	0.42	
Total	63	1099.84			Total	63	29.18		

* - p < . 01

APPENDIX D (continued)

ANALYSIS OF VARIANCE OF DATA OBTAINED WITH TRIAL SETS C, T, iC,
iT FROM EXPERIMENT II

RAW DATA					ARCSIN DATA				
Source	D.F.	SS	MS	F	Source	D.F.	SS	MS	F
A (Prior irrelevant learning)	1	494.13	494.13	3.26 (p> .05)	A	1	14.81	14.81	3.48 (p> .05)
B (Organizations)	1	1826.16	1826.16	12.03*	B	1	53.11	53.11	12.48*
AB	1	3.66	3.66	0.02	AB	1	0.20	0.20	0.48
Error(a)	60	9105.23	151.75		Error(a)	60	255.23	4.25	
J (Trials)	3	7697.94	2565.98	311.67**	J (Trials)	3	214.48	71.49	339.168**
AJ	3	26.16	8.72	1.06	AJ	3	0.45	0.15	0.71
BJ	3	67.10	22.37	2.72	BJ	3	0.81	0.27	1.28
ABJ	3	19.04	6.35	0.77	ABJ	3	0.59	0.20	0.94
Error(b)	180	1481.93	8.23		Error(b)	180	37.94	0.21	
Total	255	20721.36			Total	255	577.63		

* - p < .01
** - p < .005

APPENDIX D (continued)

ANALYSIS OF VARIANCE FOR MEANS PER SUBJECT SUMMED ACROSS TRIALS FOR CONDITIONS

C, T, iC, iT (EXPERIMENT II)

RAW DATA					ARCSIN DATA				
Source	D.F.	SS	MS	F	Source	D.F.	SS	MS	F
A (Prior ir-relevant learning)	1	123.53	123.53	3.26 (p > .05)	A	1	3.29	3.29	3.35 (p > .05)
B (Organizations)	1	456.54	456.54	12.03*	B	1	11.99	11.99	12.23*
AB	1	0.91	0.91	0.02	AB	1	0.04	0.04	0.04
Error	60	2276.31	37.94		Error	60	58.86	0.98	
Total	63	2857.30			Total	63	74.19		

* - p < .01

APPENDIX D (continued)

ANALYSIS OF VARIANCE FOR SLOPES OF LEARNING CURVE FOR EACH SUBJECT
IN CONDITIONS C, T, iC, iT (EXPERIMENT II)

RAW DATA				ARCSIN DATA					
Source	D.F.	SS	MS	F	Source	D.F.	SS	MS	F
A (Slopes C and T vs. iC and iT)	1	35.07	35.07	1.92 (p > .1)	A	1	1.03	1.03	2.20 (p > .1)
B (Slopes C and iC vs T and iT)	1	32.33	32.33	1.17	B	1	0.29	0.29	0.63
AB	1	4.38	4.38	0.24	AB	1	0.20	0.20	0.42
Error	60	1096.27	18.27		Error	60	28.22	0.47	
Total	63	1168.05			Total	63	29.74		

APPENDIX D (continued)

ANALYSIS OF VARIANCE OF DATA OBTAINED WITH TRIAL SETS C, T, cT, tC

FROM EXPERIMENT II

RAW DATA				USING ARCSIN TRANSFORMATION					
Source	D.F.	SS	MS	F	Source	D.F.	SS	MS	F
A(Prior learning with either C or T)	1	10560.88	10560.88	52.62**	A(prior learning with either C or T)	1	298.42	298.42	51.38**
B(transfer from C vs transfer from T)	1	820.12	820.12	4.99*	B (Transfer from C vs. transfer from T)	1	24.57	24.57	4.93*
AB	1	364.50	364.50	1.82	AB	1	10.99	10.99	1.89
Error(a)	68	13646.30	2000.68	**	Error(a)	68	394.91	5.81	
J (Trials)	3	4672.85	1557.62	222.62.	'J' (Trials)	3	134.96	44.98	**
AJ	3	487.80	162.60	23.24**	AJ	3	13.02	4.34	240.97**
BJ	3	7.74	2.58	0.37	BJ	3	0.04	0.02	23.25**
ABJ	3	4.75	1.58	0.23	ABJ	3	0.09	0.03	0.08
Error(b)	204	1427.36	6.99		Error(b)	204	38.08	0.19	0.17
Total	287	31992.32			Total	287	915.10		

* p < .05

** p < .005

APPENDIX D (continued)

TABLE 7

DUNCAN'S NEW MULTIPLE RANGE TEST FOR UNEQUAL n's APPLIED TO THE DIFFERENCES BETWEEN MEANS OBTAINED ON TASKS iT, iC, tC, cT (EXPERIMENT II)

Means	iT	iC	tC	cT
	15.375 (29.60%) (n=14)	20.518(39.40%) (n=14)	26.694(51.38%) (n=18)	27.819(53.50%) (n=18)
$(\bar{X}_B - \bar{X}_A) \sqrt{\frac{2n_B n_A}{n_B + n_A}}$ **	Shortest Significant Ranges (R_{α}^1)			
	.05			
For cT and iT: 49.390	$R2^1 = 22.326$		$R2^1 = 29.690$	
For cT and iC: 28.978	$R3^1 = 23.486$		$R3^1 = 30.952$	
For cT and tC: 4.773	$R4^1 = 24.252$		$R4^1 = 31.813$	
For tC and iT: 44.925				
For tC and iC: 24.512				
For iC and iT: 19.245				

** For a difference between any two means to be significant $(\bar{X}_B - \bar{X}_A) \times \left(\frac{2n_B n_A}{n_B + n_A} \right)^{\frac{1}{2}}$ must exceed the appropriate Rk^1 .

APPENDIX D (continued)

TABLE 9

DUNCAN'S NEW MULTIPLE RANGE TEST APPLIED TO THE DIFFERENCES BETWEEN MEANS OBTAINED

ON TASKS T, C, tC, cT (EXPERIMENT II)

Means	T 12.333	C 17.958	tC 26.694	cT 27.819	Shortest Significant Ranges (.05)
T 12.333		5.625	14.361	15.486	R2 = 4.722
C 19.958			8.736	9.861	R3 = 4.967
tC 26.694				1.125	R4 = 5.129

APPENDIX D (continued)

TABLE 10

DUNCAN'S NEW MULTIPLE RANGE TEST FOR UNEQUAL n'S APPLIED TO THE DIFFERENCES BETWEEN MEANS OF SLOPES SUMMED ACROSS Ss FOR CONDITIONS tC, cT, iT, iC (EXPERIMENT II)

Slope Means	tC	cT	iT	iC
	4.194 (n=18)	4.305 (n=18)	6.042 (n=14)	7.875 (n=14)
$(\bar{X}_B - \bar{X}_X) \sqrt{\frac{2n_B n_A}{n_B + n_A}}$	Shortest Significant Ranges (Rk^1)			
	.05			
	.01			
For iC and tC: 14.610	$R2^1 = 11.180$	$R2^1 = 14.867$		
For iC and cT: 14.169	$R3^1 = 11.761$	$R3^1 = 15.499$		
For iC and iT: 6.859	$R4^1 = 12.144$	$R4^1 = 15.930$		
For iT and tC: 7.335				
For iT and cT: 6.894				
For cT and tC: .471				

APPENDIX D (continued)

TABLE 11

DUNCAN'S NEW MULTIPLE RANGE TEST FOR THE DIFFERENCES BETWEEN MEANS OF SLOPES SUMMED ACROSS
Ss FOR CONDITIONS tC, cT, T, C - THE CORRESPONDING ANALYSIS OF VARIANCE IS SHOWN ON PP.
APPENDIX (EXPERIMENT II)

Slope Means	tC 4.194	cT 4.305	T 7.930	C 8.777	Shortest Significant Ranges (.05)
tC 4.194		.111	3.736	4.583	R2 = 1.795
cT 4.305			3.625	4.472	R3 = 1.888
T 7.930				.847	R4 = 1.950

APPENDIX E

SAMPLE RESPONSE SHEETS

SCORE: $\frac{27}{67}$

Subject (SUB) List

TRIAL #

(Experiment I)

1. Ever since time immemorial/man has wondered about the nature of light./
7. In medieval times,/the treatment of demented persons was not one of compassion/and sympathetic listening/but one of brutality/and persecution./
5. In 1803,/Young/proves that light consists of waves/when he passed a beam through two pinholes/and this set up interference patterns/like the waves of water./
10. In 1780,/Young/questioned the witchcraft theory/by saying if the insane are all witches/why do the insane frequently/perform witchcraft unsuccessfully;/this was the beginning of the attack on the witchcraft theory./
2. In 1704,/Newton/in England/thought that light is made up of particles./
8. Before the publication of the book/the Witch Hammer/Newton/in 1720/thought that mental disease was due to being perverse,/witch-natured,/and possessed of the devil./
6. Later,/in 1840,/the kind of waves that light is made up of was discovered by/Fresnel/and Arago./
11. The first step forward was/made/in 1793/by Fresnel/and Arago;/the latter freed the insane/from their chains/and encouraged a sympathetic hearing of their troubles./
3. In 1750,/it is interesting to note/Lebon/said if/light consists of particles,/why do we not feel the particles bouncing on our eyes./
12. Later,/in 1810,/Lebon/continued the work of/Fresnel/and Arago,/and fought for the establishment of mental hospitals./
4. Huggens,/in the late 18th century,/was unable to answer the scientist's question,/but conceived light as consisting of waves;/this view urged scientists to do their experiments./

APPENDIX E (continued)

Subject (SUB) List (continued)

9. This atmosphere continued to persist; in 1740 Huggens in Germany, published a book entitled the Witch Hammer which associated mental disorders with witchcraft and asserted that the insane should be tortured and burnt.

APPENDIX E (continued)

SCORE: $\frac{36}{52}$

Causal, not Temporal (C) List

TRIAL #

(Experiment II)

1. In 1803, Thomas Young, because he was skeptical of the ideas of Newton, attempted to prove that light consists of waves by passing a beam through two pinholes and showing that it set up interference patterns like the waves of water.
2. Before the experiment of Young, in 1704 precisely, Newton having shown that light travels in a straight line thought that light might, therefore, consist of particles.
3. However, in 1740, a scientist said if light consists of particles, why do we not feel the particles bouncing on our eyes; although this question was ignored, Young was nevertheless urged to do his experiment.
4. Thus by 1830, the wave theory of light came to be accepted not only because of the experiment of Young but also because of the one by Fresnel and Arago which had conclusively shown that light is made up of waves.
5. In 1793, Philippe Pinel disgusted with the way the insane were treated revolutionized their treatment by freeing them from their chains, and establishing a more humane treatment.
6. Before this, in 1350, the mentally disturbed were brutally treated because it was thought that mental disease was due to being perverse and possessed of the devil.
7. This idea was taken so seriously, that in 1710 a book appeared entitled the Witch Hammer which associated mental disorders with witchcraft.
8. But by the 1820's, however, Dorothea Dix, as a result of the work of Pinel, fought for a more understanding approach to mental disorders.

APPENDIX F

INSTRUCTIONS TO SUBJECTS

Experiment I

The goal of this experiment is to find out which of several different types of organizations of verbal information is more effective in learning. We are also interested in determining which is the most frequent or predominant way for individuals to organize information. By comparing amount of learning in different organizations we hope to gain some answers to these questions. You should also realize that the topic of organization is an important one since it is doubtful, when learning or thinking, that people store or recall events in random, unordered fashion. Organization is a central factor in the operation of intellectual processes.

Information in the form of sentences will be played twice on the tape-recorder. You are requested to listen to it carefully and try to learn as much as you can. After that, you will be asked to recall the sentences in the order you heard them on the tape-recorder. At the termination of the second presentation of the information, you will try and repeat the first sentence you heard on the tape-recorder. After a certain amount of time this first sentence will be projected on the screen for you to read it. As soon as this sentence is flashed off, try and recall the sentence you heard secondly on the recorder. Then this sentence will be projected and again you are to read it. You shall go on in this sequence until the last sentence. However, we shall go through the entire list of sentences five times or for five trials.

This procedure is called the serial anticipation method of learning. In this procedure you anticipate what the next sentence is as soon as the preceding one is flashed off from the screen, at which point I will say "next".

In regards to the design of the experiment, there are several groups of subjects and each group learns the same sentences. What differs from group to group is the ordering or organization of the information. At the end of the study, amount of learning for each of the groups will be compared.

Please seat yourselves comfortably and face the screen. When you are speaking, please try to be as clear as possible as to what you mean, and enunciate as sharply and clearly as you can so the experimenter can understand what you say. Now we shall start.

APPENDIX F (continued)

Experiment II

This experiment is designed to determine first, which of several different types of organizations of verbal information is more effective in learning, and secondly, how much facilitation or effect does each of the different organizations have on subsequent learning. We hope to obtain some answers to these questions by letting different groups of subjects learn identical information in different organizations. More precisely, each group learns information which is the first time organized one way and the second time organized another way. The difference between the groups is that what is learned first in one group may be learned second in another, and vice-versa. By comparing amount of learning for each organization and the difference between first and second learning for each group we hope to answer some of the above questions.

You should bear in mind that the topic of organization is an important one since it is doubtful, when learning or thinking, that people store or recall events in random, unordered fashion. Organization is a central factor in the operation of intellectual processes.

Information in the form of sentences will be played twice on the tape-recorder. You are requested to listen to it carefully and try to learn as much as you can. After that, you will be asked to recall the sentences in the order you heard them on the tape-recorder. At the termination of the second presentation of the information, you will try and repeat the first sentence you heard on the tape-recorder. After a certain amount of time this first sentence will be projected on the screen for you to read it. As soon as this sentence is flashed off, try and recall the sentence you heard secondly on the recorder. Then this sentence will be projected and again you are to read it. You shall go on in this sequence until the last sentence. However, we shall go through the entire list of sentences four times or for four trials. Following the termination of the fourth trial, you will listen again to two recordings of a list of sentences and go through the identical type of four learning trials for this list.

This procedure is called the serial anticipation method of learning. In this procedure you anticipate what the next sentence is as soon as the preceding one is flashed off from the screen, at which point I will say "next".

Please seat yourselves comfortably and face the screen. When you are speaking, please try to be as clear as possible as to what

APPENDIX F (continued)

you mean, and enunciate as sharply and clearly as you can so the experimenter can understand what you say. Now we shall start.

APPENDIX G

SCORES FOR NUMBER OF PHRASES RECALLED FOR EACH
 SUBJECT ON EVERY TRIAL IN EACH GROUP IN BOTH
 EXPERIMENTS

SCORES FOR RECALL OF PHRASES FOR EACH SUBJECT
 IN EACH TRIAL IN THE CTW GROUP - EXPERIMENT I

<u>Ss</u>	TRIALS				
	1	2	3	4	5
1	11	20	33	47	48
2	18	24	28	32	36
3	17	16	25	24	30
4	11	20	28	30	32
5	14	25	27	32	32
6	14	19	21	32	35
7	2	13	24	35	39
8	12	17	27	34	31
9	7	16	19	32	35
10	12	19	36	44	38
11	14	20	22	30	37
12	14	22	37	43	43
13	7	k3	26	28	29
14	20	28	35	36	41
15	17	33	38	47	50
16	9	18	27	29	32
17	6	12	17	16	22
18	22	33	44	43	50
19	23	36	39	43	46
20	15	21	32	37	45

APPENDIX G (continued)

SCORES FOR RECALL OF PHRASES FOR EACH SUBJECT
IN EACH TRIAL IN THE C GROUP - EXPERIMENT I

<u>Ss</u>	TRIALS				
	1	2	3	4	5
1	9	14	26	36	37
2	15	22	23	25	29
3	1	3	5	7	13
4	7	14	28	33	40
5	7	9	22	27	35
6	8	18	25	33	38
7	9	16	13	19	18
8	12	16	25	31	39
9	2	3	7	6	8
10	11	11	16	22	24
11	13	18	24	27	34
12	5	6	14	19	20
13	14	26	38	41	47
14	5	10	11	17	18
15	14	18	29	26	32
16	14	16	23	24	31
17	4	9	18	22	30
18	5	7	12	11	15
19	4	6	16	18	33
20	13	24	19	17	22

APPENDIX G (continued)

SCORES FOR RECALL OF PHRASES FOR EACH SUBJECT
IN EACH TRIAL IN THE SUB GROUP - EXPERIMENT I

<u>Ss</u>	TRIALS				
	1	2	3	4	5
1	9	17	23	23	33
2	2	6	13	17	19
3	5	11	20	25	30
4	10	5	7	19	23
5	7	18	24	27	30
6	12	19	33	43	46
7	6	15	20	26	34
8	17	26	34	40	40
9	0	1	1	7	10
10	0	7	10	20	19
11	19	22	36	40	47
12	3	1	6	8	16
13	3	7	11	12	12
14	4	6	12	14	19
15	2	1	9	10	14
16	3	2	7	7	8
17	14	23	27	29	37
18	2	8	11	15	18

APPENDIX G (continued)

SCORES FOR RECALL OF PHRASES FOR EACH SUBJECT
IN EACH TRIAL IN THE CT GROUP - EXPERIMENT II

<u>Ss</u>	C TRIALS			
	1	2	3	4
1	9	16	23	28
2	7	10	14	21
3	5	10	17	16
4	6	7	10	13
5	10	13	18	26
6	11	12	15	21
7	5	7	12	14
8	6	14	20	23
9	8	18	20	27
10	14	17	23	28
11	10	13	25	25
12	14	20	22	28
13	17	21	29	31
14	6	10	12	16
15	16	24	29	35
16	16	20	26	32
17	13	22	28	37
18	17	20	29	36
<u>Ss</u>	T TRIALS			
	1	2	3	4
1	33	33	29	35
2	32	33	34	38
3	16	19	18	24
4	10	10	15	14
5	27	26	28	39
6	19	23	27	28
7	8	13	15	15
8	27	24	30	34
9	24	25	34	34
10	18	25	25	23
11	17	25	24	25
12	20	30	34	38
13	25	34	34	37
14	14	17	20	27
15	37	42	43	42
16	35	29	36	37
17	34	38	41	38
18	35	37	36	38

APPENDIX G (continued)

SCORES FOR RECALL OF PHRASES FOR EACH SUBJECT IN EACH TRIAL IN
THE TC GROUP - EXPERIMENT II

<u>Ss</u>	T TRIALS			
	1	2	3	4
1	10	15	26	32
2	5	11	16	17
3	3	10	11	15
4	5	14	13	19
5	7	10	20	24
6	5	6	16	18
7	2	9	13	10
8	2	8	22	27
9	7	14	17	22
10	2	2	3	7
11	8	12	13	18
12	8	11	11	15
13	3	4	6	14
14	1	2	6	9
15	8	16	19	29
16	9	19	18	29
17	4	4	9	11
18	11	14	23	29

<u>Ss</u>	C TRIALS			
	1	2	3	4
1	37	37	32	39
2	14	20	19	25
3	23	29	32	28
4	22	24	26	28
5	34	31	38	41
6	27	27	30	33
7	20	25	27	29
8	28	28	33	37
9	22	24	28	33
10	5	8	12	14
11	22	26	26	31
12	15	23	24	28
13	16	18	19	24
14	12	11	13	13
15	30	34	37	35
16	36	39	41	41
17	15	16	21	27
18	38	40	40	42

APPENDIX G (continued)

SCORES FOR RECALL OF PHRASES FOR EACH SUBJECT IN EACH TRIAL
IN THE IT GROUP - EXPERIMENT II

<u>Ss</u>	I TRIALS			
	1	2	3	4
1	22	30	30	35
2	8	15	15	21
3	14	24	27	31
4	0	11	22	25
5	16	16	21	23
6	8	12	14	23
7	1	7	16	18
8	14	23	28	32
9	14	19	19	25
10	12	17	21	31
11	22	27	33	35
12	18	24	23	34
13	16	14	21	27
14	7	11	13	21

<u>Ss</u>	T TRIALS			
	1	2	3	4
1	11	22	28	36
2	6	12	13	18
3	18	18	24	27
4	4	9	18	18
5	3	6	10	15
6	3	3	13	14
7	3	6	8	8
8	4	10	15	18
9	11	19	20	21
10	6	17	18	22
11	19	33	36	40
12	12	25	31	34
13	5	6	14	13
14	8	7	8	15

APPENDIX G (continued)

SCORES FOR RECALL OF PHRASES FOR EACH SUBJECT IN EACH TRIAL
IN THE IC GROUP - EXPERIMENT II

<u>Ss</u>	I TRIALS			
	1	2	3	4
1	18	27	26	28
2	13	21	28	29
3	14	23	29	30
4	15	25	29	34
5	17	22	26	31
6	13	9	17	23
7	2	6	9	15
8	11	19	29	29
9	19	20	21	21
10	16	26	28	33
11	6	9	13	15
12	5	14	22	26
13	20	28	31	32
14	5	8	11	19

<u>Ss</u>	C TRIALS			
	1	2	3	4
1	12	16	25	35
2	8	14	14	20
3	22	26	34	39
4	16	25	33	34
5	11	17	18	27
6	8	17	18	26
7	5	11	14	20
8	14	21	29	36
9	10	16	19	25
10	13	25	39	39
11	7	9	15	15
12	13	20	25	32
13	14	22	32	36
14	8	13	16	21

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